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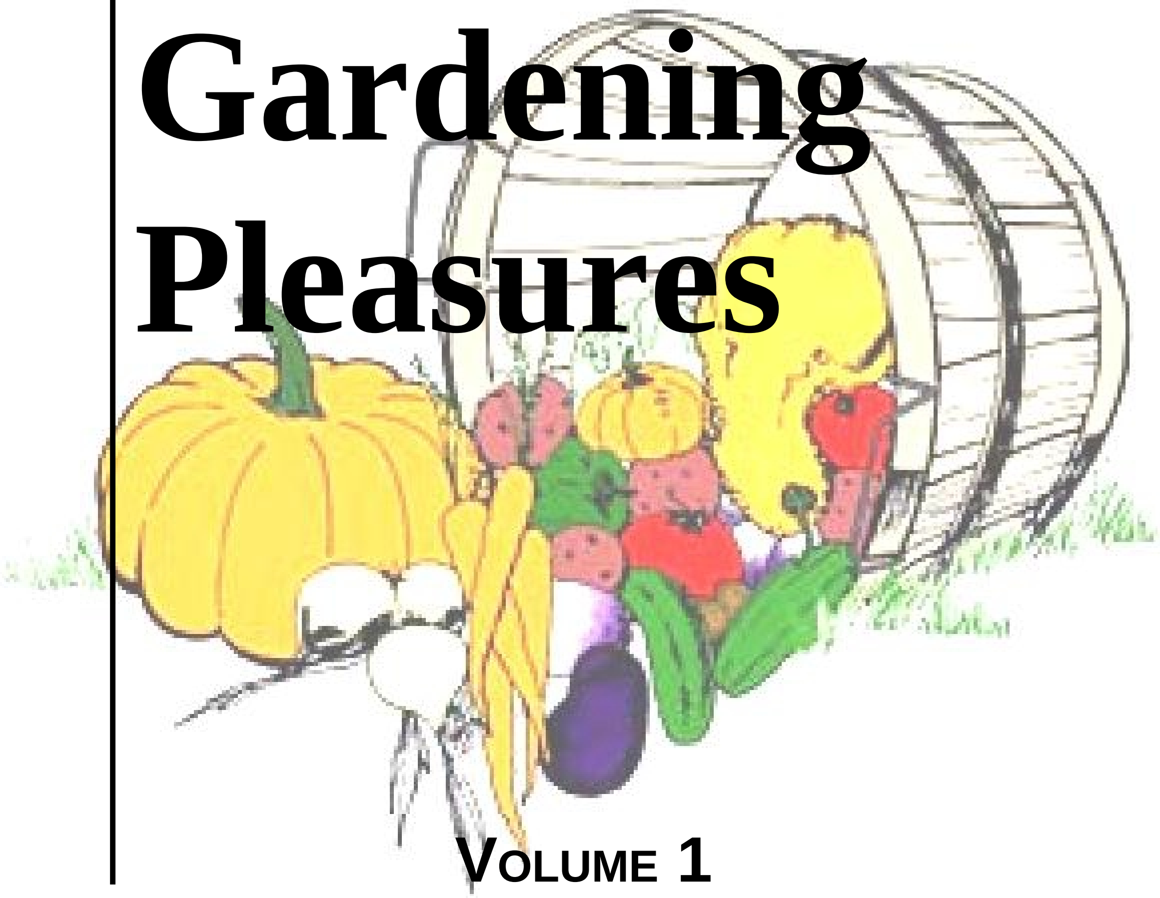

VOLUME 1

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INTRODUCTION

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First off, we'd like to thank you for downloading this free ebook. It means a lot to us, and hopefully by the time you're through reading, the feeling is mutual.

This ebook is a compilation of some of the best articles/fact sheets that we have found, both in print and on the Internet.

We're guessing your first question here is, "What exactly have I downloaded?" To answer you simply ...

Here you will learn what works for:

- Growing the best tomatoes on the block
- Getting the best lettuce that can be produced
- Working with a variety of "specialty" crops
- And much, much more!

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CHAPTER 1

HOW TO GROW CUCUMBERS THE EASY WAY

IN THIS CHAPTER, YOU WILL LEARN:

- How to start your cucumber plants
- There is a large variety of cucumbers available to you
- How to deal with various pests and diseases
- How to save your own seeds for next year
- All about the ways to preserve and enjoy your harvest

How to Grow Cucumbers the Easy Way

By Lynn Gillespie

Crunch, crunch, crunch, excuse me, this is the sound of me munching a cucumber just plucked from the vine, fresh cucumbers from the garden are hard to beat! I think cucumbers are the second most popular vegetable in the garden right behind tomatoes.

My favorite way to grow my cucumbers is in a raised bed system. Not just any old system but a cinder block garden. This garden system requires no hammer, nails or wood. It uses cinder blocks for the walls. Inside the blocks I use a special soil mix that feeds the plants all season without any extra fertilizers. This system uses 1/4 the space of a conventional row garden. It requires 1/4 the time and water to grow the same amount of food as a conventional row garden.

Why do it the hard way when cucumbers can be grown so easily and care free in a cinder block garden?

I plant six cucumber hills for my family of five people. There are three for pickle making and the other three are for fresh eating. This is plenty of cucumbers for us and the chickens. If there are only one or two people at your house, still plant two cucumber plants. Unknown things happen to cucumber plants. If your plant dies and you only have one you are out of luck.

I can get approximately 32 pounds of cucumbers from a 40 inch by 40 inch bed. I grow the cucumbers up on a trellis to save garden space and also the trellis keeps the vines drier and that in turn prevents most diseases.

GETTING STARTED

Cucumbers can be started in the house, in the garden or you can purchase starter plants from a nursery.

HOUSE CUCUMBERS

Cucumbers are really easy to start in the house. If you want a jump on the growing season, you can start your cucumbers in the house. The plants grow really fast so start your cucumbers only 3 weeks before your last frost date. To start your seeds you will need some sterile potting soil and some biodegradable pots. Cucumbers are picky about having their roots disturbed. Plant your cucumbers in a

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biodegradable pot such as a peat pot or a newspaper pot. The cucumbers like a four inch pot. Plant 4 seeds per pot and leave the plants together. When you plant the cucumbers outside, plant the pot and all and leave the 4 plants together, this is called a hill. Grow your cucumbers in a sunny window until it is time to plant them out. Once the plants have four leaves, it is time to start feeding them with half strength liquid fertilizer or some compost tea.

Before you plant your cucumbers outside, harden them off. What does this mean? The plants like people who have been in the house are sensitive to the sun and can sun or wind burn easily. Expose your cucumbers to the sun a little at time to get them use to being outside. It will take 4 to 7 days to get your plants ready to live outdoors permanently. Start hardening the plants a week before it is time to plant them out. Hardening off also applies to the plants that you pick up at the local nursery if they have been in a greenhouse. Below is an ideal hardening off schedule. Follow it the best you can or modify it to fit your needs.

Day 1: Set the plants out in an area that is free of wind, warm above 60F and will only get a few hours of sun. The plants can stay out as long as it is warm, wind free and little sun. Be sure to check the soil moisture frequently, the plants have a tendency to dry out fast when they are set outside.

Day 2: Set the plants out for 3 hours in the sun and a slight breeze, be sure that the temperature is warm. Check soil moisture.

Day 3: Set the plants out in the sun for 4 hours in a breeze, and still in the warmth of the day. Check soil moisture.

Day 4: Set the plants out for 5 hours in the sun and breeze, but not windy. Set them out earlier in the day to get some cool air. Check soil moisture.

Day 5: Leave the plants out all day in the breeze and in the sun. Be sure to check the soil moisture. The plants may need to be watered more than once on a warm day. I put my plants in a shallow dish of water and let them wick up all the water they want.

Day 6: Leave the plants out all day and all night if it is above freezing. They should be fairly tough by now. Check soil moisture.

Day 7: Plant the plants in the garden. If a frost is predicted during the next 7 days, cover your plants. Water in well.

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GARDEN START

If you start your cucumbers in the garden, plant 4 seeds in one spot called a hill. Water well and keep moist until the seedlings emerge. Once the seeds are up, they will not need wind or sun protection but a frost will kill them. Black plastic on the ground can help to warm the soil and help the cucumbers to grow faster.

WHAT KIND SHOULD I PLANT?

I love to grow cucumbers, there are so many shapes and sizes to choose from.. Let's explore the different types. There are hybrid cucumber seeds (seeds that are cross bred to enhance a feature) and there are non-hybrid seeds (the kind grandma use to grow every year and save the seed from). I use non-hybrid in my garden so I can save my own seeds. In the south and places of high humidity, the hybrids are more necessary because they have been bred to resist certain diseases that come along with the heat and humidity. Ask a neighbor gardener which seeds he likes best, this will give you a clue as to which seeds will work best in your area. Any seed that is a hybrid should have the word hybrid on the label. If it is not labeled it should be a non-hybrid.

Burpless These cucumbers have less "burp" in them. They are milder on your stomach, if you have trouble eating regular cucumbers because they make you burp then the burpless are for you.

Armenian (65 days) Armenian is the mildest of all cucumbers. It is actually in the squash family, but taste like a cucumber. These cucumbers can get up to 3 feet long. They are light green and ribbed. Harvest can start when the cucumber is 10 inches long. They like really warm weather and will not do anything until the weather warms up. They like to grow on a trellis. These are great cucumbers and once you try them, you will want to grow them every year. This cucumber is a non-hybrid and you can save the seeds to grow a new crop.

Muncher (65 days) This is a great burpless cucumber. It is a heavy producer. Pick the cucumbers small for the best flavor. Our family grows a lot of these burpless cucumbers. This is also a non-hybrid and you can save the seeds off of it to grow a new crop.

Other burpless cucumbers that are hybrid but are not reliable for seed saving are: Tasty Green Hybrid, Tasty King Hybrid, Sweet Slice Hybrid, Burpless Orient Express

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EUROPEAN CUCUMBERS

European Cucumbers are typically grown inside a greenhouse. Sometimes you can find them in the supermarket in shrink wrapped plastic. They taste great and require no peeling. The seeds are extremely expensive but they will grow outdoors if you really want to grow them.

Hybrids are the only varieties I know of and they are: Aria, Tyria, and Sweet Alphee.

PICKLING CUCUMBERS

I use to think you could pickle any cucumber and it would turn out great. I always wondered why my pickles we so soggy. Then I wised up, I now use a pickling cucumber and pickle it when it is small. Finally, I am getting crunchy pickles!

National Pickling (54 days) This is definitely a pickle cucumber. It has lots of prickles on it. Pick these really small (3 to 4 inches) for the best pickles. By using a pickle type cucumber, you will get a crisper product when canned. My family will eat 20 quarts of these pickles every year. Our family pickling recipe is listed below. This is a non-hybrid cucumber and you can save the seeds off of it for next year's crop.

Some of the hybrid pickling cucumbers are: Carolina, Calypso, Bush Pickle Hybrid, Fancipak Hybrid, Hybrid Miss Pickler, Hybrid Gurney's Burpless, Hybrid Lucky Strike, Wisconsin SMR-18 and Everbearing.

SLICERS

If you want a cucumber like the regular one's you buy in the supermarket, these are all considered slicers.

Straight Eight (58 days) This is the most popular type of cucumber. It is about 8 inches long and 2 inches wide. These are great cucumbers and are heavy producers. You can pickle them if you pick them young. This is a non-hybrid and you can save the seeds for next year's crop.

Marketmore 76 (68 days) This cucumber sets fruit that are 8 to 9 inches long. The fruit is dark green and very tasty. This is a non-hybrid and you can save the seeds.

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Some hybrid slicers are: Hybrid Bush Crop, Fanfare Hybrid, Jazzer, Park's Whopper Improved, Hybrid Sweet Slice, Hybrid Sweet Success.

"FUNNY" CUCUMBERS

It is sometimes fun to grow a novelty cucumber. Lemon (64 days) cucumbers are right at the top of the list. These are 3 inch round yellow cucumbers. They look like lemons but taste like cucumbers. They are a fun novelty and look great in salads, they taste good too!

If you want a square cucumber, place a small cucumber (while it still hangs on the vine) in a square container and let it grow to the shape of the container. If the container had a face on the inside, the cucumber would mold to the shape of the face. Just think of the variations you could come up with using this idea!?!

PROBLEMS

Once in a while you will run into a problem with your cucumber plants. I am inclined to pull up the plants if they show signs of diseases or are really infested in bugs. If they are not to bad and you want to try to save the plants here are some hints.

PESTS OR DISEASE?

Cucumber beetles can attack your cucumber plant. This beetle can carry a bacteria wilt. This wilt can take down a cucumber plant really fast. It will wilt and die. There is no cure so pull up the plant a throw it away or burn it.

Aphids are soft, pear-shaped bodied insects that suck the juice out of your plants. Some aphids have wings. Most aphids are green but they also come in red, yellow, gray and black. Aphids are about 1/8 inch long, have 6 legs and are born pregnant. Yep, they are born pregnant. Female aphids can give live birth to pregnant females, occurring for several generations. In the fall, the female aphids mate with a male to produce eggs that winter over.

Aphids secrete a sticky honeydew substance from their rear. Ants will carry the aphids around and harvest the honeydew from the aphids. In the fall ants will carry aphid eggs into their nest and take care of the eggs until spring. In the spring the ants will return the aphid eggs to the plants. If you have an ant invasion, look for aphids as well. To eliminate aphids there are several methods:

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1. Wash the aphids off the plants with a strong spray of water.

2. Tobacco spray: Soak tobacco leaves in water for 24 hours. Dilute solution until it looks like weak tea. Then spray on plants. Be sure to hit the bug with the spray. Aphids tend to hide on the underside of leaves and on the main stems.

3. Rhubarb spray: Boil one pound of rhubarb leaves in 1 quart of water. Next take two cups of water and mix in one tablespoon of dish soap. When the rhubarb has cooled pour off the liquid and add it to the soapy water. Spray on aphids.

4. Safer Soap™: Safer Soap™ is a product you can purchase at a local nursery. It works well on aphids if you can get it on the body. It kills by suffocation. Aphids breathe through their pores. Safer Soap ™clogs their pores and they can't breathe.

5. Neem oil: Neem oil is a byproduct of the Neem tree seed. It is considered a natural way of killing aphids. Local nurseries will carry Neem oil.

6. Diatomaceous earth: Diatomaceous earth is ground up fossilized sea shells. Diatomaceous earth will puncture soft bodied insects and they will dehydrate and die. Local nurseries should carry diatomaceous earth.

7. Home-made soft bodied bug spray: Mix three tablespoons of dish soap and one gallon of water. Spray on the aphids every other day for two weeks. Test plants first to see if the soap will burn the leaves.

8. Non-fat for aphids: To control aphids apply non-fat dried milk, mixed according to the instructions on box. Spray the leaves of your plants with the milk. The aphids get stuck in the milky residue and perish.

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9. Repellant spray: This can be used to repel aphids and whiteflies, slugs and cut worms. Reapply after rains or once a week. Mix one minced bulb of garlic, one small minced onion, one tablespoon cayenne pepper, one quart water. Let steep for three hours. Next add one tablespoon liquid soap. Strain and put in sprayer. Spray on plants.

10. Garlic oil spray: Use for control over aphids, cabbage loopers, earwigs, June bugs, leafhoppers, squash bugs, and whiteflies. Mince one bulb garlic and soak in two teaspoons mineral oil for 24 hours. Next, mix one pint of water with one tablespoon liquid soap then add garlic mix to water and soap. Mix throughly. Strain out garlic and place into a jar for storage. Use one to two tablespoons garlic oil mix to two cups water. Spray plants covering all leaf surfaces.

11. Alcohol sprays: Use for aphids, mealybugs, scale, thrips and whitefly control. Mix ½ cup isopropyl alcohol (70%) with one cup water and spray on leaves and pests. Alcohol can burn the leaves of certain plants. African violets and apple trees are sensitive to alcohol sprays. Test a few leaves on your plant before you spray the whole plant.

12. Yellow sticky traps: To catch whiteflies, gnats and aphids use STP™ motor oil treatment or honey. Smear motor oil treatment or honey onto bright yellow plastic and place it amongst your plants with bugs. When the plastic gets full of bugs, wipe it off and reapply STP™ motor oil treatment or honey and set the trap out again.

13. Pyrethrins: Pyrethrins are extracts from a chrysanthemum. Dust or sprays are available from local nurseries.

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14. Rotenone: Rotenone is a product derived from the root of two different legumes (the bean family). Rotenone has been used as a pesticide since 1649 in Europe. Dust or sprays are available from local nurseries.

Bitter Cucumbers: If you are experiencing bitter cucumbers, then you are letting the cucumbers get to large before you are eating them. Keep the watering even, this will help the cucumbers to stay bitter free.

SAVE YOUR OWN SEEDS AND SAVE A BUNDLE

Seeds are so expensive these days. Saving seeds was a way of life for people just a few generations ago. There are great advantages to saving your own seeds. Money is one but the best thing is that once you start saving the seeds from your best plants, the seed will start to adapt to your garden and will be better seeds than you can buy. Saving cucumber seeds is easy, give it a try. The main requirement is that your cucumbers are annuals and will make seeds the same year as they are planted. Cucumbers will not cross pollinate with melons or squash. They will cross pollinate with other cucumbers. Bees pollinate cucumbers.

If you want to save seeds from cucumbers and you have only one variety you can select the best cucumber to grow to maturity. If you have more than one variety you will need to hand pollinate. Hand pollinating is easy once you know a few tricks.

First, you need to identify the female flower from the male flower. The female flower has a baby cucumber at the bottom of the flower. The male flower has a straight stem that leads to the bud. Our goal is to pollinate the female flower with a known male flower of the same variety to get a pure seed. To do this we need to keep the female and the male from the bees. Just as the flowers are ready to open, (you can tell this by the yellow coloring) cover the flowers with a paper sack. Tie, staple or clip the bag shut so no bees can get in. In the morning, pick the male flower. Ever so gently, tear off the petal to expose the stamen (the bright yellow part with the yellow dust on it). Remove the bag from the female flower and gently remove the petals (don't pick the flower). Now rub the male flower dust onto the sticky yellow part of the female flower. Once pollinated, place the bag back over the female flower and leave it there for 4 days. Be sure no bees can get into the bag. Once the bag is removed, mark the cucumber with a ribbon to know it is for seed.

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The cucumber saved for seed needs to remain on the plant for 5 more weeks than a cucumber that is picked for eating. The cucumber will turn a yellow or white color when ripe.

After the cucumber has ripened, remove the seeds with a spoon. Place them in a bowl of water for 5 days, stirring every day. This will remove the slick covering of the seeds. Once the seeds are rinsed throughly, place them on a plate to dry. Pack the seeds away in a glass canning jar once they are dry.

HOW MANY WAYS TO EAT A CUCUMBER

Cucumbers are best fresh but can be preserved for the winter as a pickle, relish or dried as chips.

CANNING

There are thousands of pickle recipes because pickles are the best way to keep a cucumber. My family likes dill pickles. I make them without a crock right in the jars.

First, start out with pickling cucumbers. These are different than eating cucumbers. The easiest way to tell them apart is that pickling cucumbers have large spines on them. Pick the pickling cucumbers when they are very small. If you are going to do whole pickles get them before they reach 3 inches. For slicers you can pick the cucumbers at 4 to 5 inches but no bigger.

DILL PICKLES

This recipe comes from a family dear to my heart. This was Salome Marta's Dill Pickle recipe that has raised a peck of children.

Gather up about 8 pounds of cucumbers less than 5 inches long. Wash cucumbers and slice or leave whole. In a large pot boil 1 quart cider vinegar, 3 quarts water and 1 cup pickling salt. In quart jars put 1 clove garlic, 1 head fresh dill and pickles. Pour boiling liquid over pickles. Seal jars and cook in hot water bath for 10 minutes. Add 1 grape leaf to each jar for extra crispness.

DEHYDRATING

Now try this before you turn your nose up. Dried cucumbers make great dipping chips all winter long. Slice your cucumbers with the peel on to 1/4 inch thick. Lay on dehydrating rack and dry at 130-140F until brittle. Store in air tight container in a cool dry place. Eat with dip or crumble and sprinkle on salads.

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VINEGAR PICKLES

This is the way most of our fresh pickles that don't get eaten in the garden (by us) are prepared. Mix 1/3 cup vinegar with 1 cup water and 1 teaspoons of salt. Soak cucumbers in vinegar and salt for two hours before eating. You can put some slices of onion in the mix as well. I leave the bowl out on the counter after dinner and by bed time, someone has eaten all the left overs. If this recipe is to strong for your family, add more water.

CREAMED CUCUMBERS

2 cucumbers peeled and sliced thin
1 tablespoon salt
Mix salt and cucumbers and let sit for one hour. Rinse well and squeeze extra moiture out of cucumbers.
Mix ½ onion chopped, 1 tablespoon vinegar, ½ teaspoon paprika and 8 ounces of sour cream. Stir this mixture in with the cucumbers. Refrigerate for 2 hours before serving. You might want a double batch, this stuff is sooooooo goooood!

Cucumbers are really easy to grow in the garden and can be a lot of fun for the kids.

Lynn Gillespie is author of the book *Cinder Block Gardens*. Gardening made simple and easy the way gardening should be! You are invited to visit Lynn’s web site at: http://www.lynngillespie.com/z106.htm

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CHAPTER 2

TOMATOES IN THE HOME GARDEN

IN THIS CHAPTER, YOU WILL LEARN:

- How to pick the proper planting site
- Properly prepare the soil and fertilization
- How to grow your own transplants
- How to properly plant into the garden
- How to grow your tomatoes for maximum production

Tomatoes in the Home Garden

Nebraska Cooperative Extension, G80-496-A

This guide outlines tomato rearing practices, cultivars and possible pest, disease and weed control problems.

Tomatoes come in a wide range of fruit colors, sizes, shapes and maturities. Ripe tomatoes may be red, yellow, orange, pink or even green. Shapes vary from globe or round to slightly flattened, pear-like or cherry-sized. Often consumers complain tomatoes purchased in grocery stores are lacking in flavor or have tough skin. In a home garden, you can grow the tomatoes you prefer, including a wide selection of fruit colors, flavors, textures and sizes. Although rumored, there is no direct link between fruit acidity and color. Preference for one fruit over another is due more to cultivar differences in flavor and texture. Each plant typically will produce 10 to 15 pounds of fruit.

Cultivars may have a determinate plant structure, growing only to a given height; while others show indeterminate or continuous growth until killed by frost. Generally, the earlier maturing cultivars are determinate. Certain tomato cultivars have been developed for special uses such as stuffing or longer storage. Greenhouse production requires specific cultivars adapted to the lower light and higher humidity levels characteristic of greenhouses. Cherry-type tomatoes are productive and have small fruit. Very dwarf cultivars adapted for growth in pots or other containers are also available. Most of these "patio" cultivars have cherry-sized fruit, although a few produce regular-sized fruit.

Tomatoes developed for commercial field production generally ripen over four to six weeks. Many of the earlier maturing cultivars have a determinate plant type combined with a concentrated fruit set. These will not produce tomatoes continuously but are grown for early production. Most home gardeners will want to plant both determinate and indeterminate tomato cultivars for a long season of fresh tomatoes. Determinate tomatoes are ideal for canning or freezing. Most newer cultivars are resistant to or tolerant of certain diseases. This is usually indicated by a letter following the name, such as "N" for nematodes, "F" for fusarium, "T" for tobacco mosaic virus and "V" for verticillium wilt. Although open-pollinated "heirloom" cultivars are now popular, many have little genetic resistance to common

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diseases. These older cultivars should be planted in ground that has not had any solanaceous crops (tomato, pepper, eggplant or potato) for at least three years and in a place with good air circulation to reduce the opportunity for fungal infection.

Tomatillos ("husk tomatoes") and ground cherries are sometimes confused with tomatoes. These plants belong to the genus *Physalis* rather than the tomato genus *Lycopersicum*.

PLANTING SITES

omato plants should be planted in full sun for optimum fruit development and high production. Fertile, well-drained soil is best. Wind protection provided by slatted wooden or plastic fencing, shrubs, trees or taller crops such as corn will enhance tomato growth and yield. Individual plants may be grown in large containers, but will need more attention as the soil tends to dry out quickly.
Avoid planting tomatoes near black walnut trees as the juglone produced by walnut roots can stunt and may eventually kill the tomato plants. Juglone and walnut wilt are discussed in more detail later in the *Problems* section of this publication. It also is advisable to rotate tomatoes so they are not planted in the same place other solanaceous crops (tomatoes, potatoes, eggplant and peppers) were grown the previous year.

SOIL PREPARATION AND FERTILIZATION

Soils can be tilled or spaded in the fall after harvest or in the spring before planting. Soil should not be worked while it is wet.

Tomato plants benefit from fertilization. A soil test may be necessary to determine the fertility level of your soil. Instructions on how to collect and submit soil for testing are available from your local Cooperative Extension office. When planting in soils with high nutrient values, some or all the fertilizer may be omitted at planting. If soil nutrients are low, apply 2 to 3 pounds of a complete fertilizer (ex: 5-10-10, 6-12-12 or 8-16-16) per 100 square feet of garden area when preparing the soil.

When the first fruit is about the size of a half-dollar, scatter one teaspoon of 5-10-5 fertilizer uniformly around the plant 8 to 10 inches from the stem. Mix the fertilizer into the top 1/2 inch of soil and water thoroughly. Repeat this once or twice a month through the rest of the season.

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Do not over-fertilize. Excessive nitrogen fertilizer tends to force the plants to produce excess foliage at the expense of fruit production.

GROWING TRANSPLANTS

Home gardeners may either purchase tomato transplants or grow their own. When growing your own plants, sow the tomato seeds four to six weeks before the plants are to be transplanted outdoors. The seeds may be planted into small pots and growing containers or in flats and later transplanted into individual growing containers.

Various commercially prepared mixtures for starting seeds are available. These are easy to use because they are generally free of insects and diseases and require no preparation. However, a mixture (by volume) of two parts garden loam soil; one part either sand, perlite or vermiculite; and one part ground sphagnum peat also can be used. Pasteurize both the container and soil mix before use to destroy harmful insects and diseases. Place the moistened soil mixture in a container, cover the container tightly with aluminum foil and heat the soil at 180ºfor 30 minutes. A meat thermometer can be used to check the temperature of the soil in the center of the container. Use only oven-proof containers for this step. Whether you use a commercial mix or a homemade pasteurized soil mixture, be sure your transplant flats or small pots are clean. Disinfect previously used containers by soaking them for 20 minutes in a 5 percent solution of standard household chlorine bleach and water (most household bleach is 5.25 percent sodium hypochlorite). To make a 5 percent solution to disinfect containers, add 3/4 cup of household liquid chlorine bleach to a gallon container and then add water to make a full gallon. Allow the containers to air dry before adding the planting mix.

Cover the seeds with 1/2 inch of the planting mix. For good germination keep the soil moist and warm between 70ºand 80º Cover the flats or pots with a sheet of plastic or piece of glass to help maintain the proper moisture and temperature. Remove the cover when seedlings break through the soil surface and water just enough to keep the soil slightly moist to the touch.

Transplant young seedlings into growing containers when the stems have straightened and the first true leaves have opened, usually 10 to 14 days after sowing. When transplanting young tomato seedlings, hold the plant by a leaf as pressure on the stem can cause permanent damage. Seeds can be germinated directly in pots

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without transplanting to other containers. Pots with more than one seedling should be thinned to a single plant by cutting the tops from the extra seedlings. Pulling excess seedlings out of the pot can injure the roots of the remaining seedling.

Expose young plants to full sunlight if possible. Supplemental light may be necessary if adequate sunlight is not available. The best temperatures for growing transplants are from 65 to 75ºduring the day and 60 to 65ºat night. Both hotbeds and cold frames work well in maintaining these temperatures. Maintaining root temperatures within this range is more important than the air temperature of the foliage. Transplants may become too tall and "leggy" due to insufficient light, high daytime air temperatures, excessive fertilization, lack of air movement or seeding more than eight weeks before field planting can begin. If adverse weather prevents a planned transplanting, the seedlings' growth rate can be slowed by reducing the amount of water applied so the transplants wilt slightly between applications.

Brushing the tops of the plants 15-20 strokes once a day with your hand or a small stick or having a small fan blow gently across the seedlings for a few hours a day will also slow growth.

PURCHASING TRANSPLANTS

Most home gardeners find it convenient to buy tomato plants. When purchasing, choose sturdy, dark green plants that have stems about the size of a pencil. Preferably, the plant should not be in bloom. Leaves should be fully expanded and free of diseases and insects. Transplants are available in packs of six to eight, in flats or in individual containers. Although plants grown in individual containers may cost more, they are generally worth it. Those in individual cells or containers are transplanted with the least amount of shock as their roots are not disturbed when plants are set out in the garden. Containers should be large enough so root growth is not restricted.

TRANSPLANTING TO THE GARDEN

Plants grown indoors should be "hardened off" before planting outdoors, which enables the plant to better withstand the shock of transplanting. The hardening process should begin 10 to 14 days before planting. Begin the hardening process by moving the plants in their containers to a shady, outdoor location.

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Move the plants into sunlight for short periods each day, gradually increasing the length of exposure. Do not put tender seedlings outdoors on windy days or when temperatures are below 45º Try not to let the plants wilt during this hardening process. Tomato flowers exposed to temperatures below 50ºare likely to develop into fruit with the defect called "cat facing." If this occurs, remove the defective fruit to enhance additional flower formation and fruit set.

Transplant hardened seedlings into the garden when the risk of frost is low. The frost free date in Nebraska varies from year to year and location to location. Protect the plants with paper or plastic covers, newspapers or boxes if there is danger of frost. Research has shown plastic tubes filled with water, sold commercially as "Wall o' Water," are superior to paper "hot caps" or plastic milk containers in allowing sufficient light and adequate temperature moderation for tomato growth early in the season.

Set the plants slightly deeper in the soil outdoors than they were growing in the container. If the plants are tall, you can set them as deep as the second set of true leaves.

If plants are in peat pots, tear back the peat on one side of the pot. Press the soil firmly around the plant to form a slight depression to hold the water. The edges of the peat pot must remain covered with soil. If exposed, the peat pot serves as a wick for water evaporation and the plant will quickly dry and may die. Water the plants immediately and then double check to ensure all edges of the pot are covered with soil.

Distance between plants depends on two things: cultivar and growing method. Set unstaked plants 3 feet apart in rows 4 to 5 feet apart. If the plant will be staked, plant them 18 to 24 inches apart in rows 3 feet apart. Caged tomatoes are best spaced 24 to 36 inches apart in rows 4 feet apart.

SEEDING OUTDOORS

While tomato seeds can be planted directly outdoors in Nebraska, the length of the production season usually is reduced. Sow the seeds 1/2 inch deep in rows 4 to 5 feet apart. Keep soil moist until the seeds germinate. When the seedlings have developed at least one true leaf, thin them so they are spaced 3 feet apart.

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WATERING

Tomatoes need about 1 to 2 inches of water each week. This varies according to temperature, type of soil, rainfall and whether a mulch is used. Sandy soils, for example, require more frequent watering. Heavy weekly soakings are better than frequent light soakings that tend to maintain shallow root systems. Mulching helps reduce water loss.

STAKING AND CAGING

Staking or placing cages around the plants makes it easier to harvest and, in some cases, to cultivate tomatoes. When staking plants, use wooden stakes about 8 feet long and 1 1/2 inches wide. Insert the stakes about 4 inches from the plant. Do this soon after transplanting to prevent root damage. Set the stakes 1 1/2 to 2 feet deep for good support.

Tie strips of cloth, nylons, soft cord or commercial ties around the stake and under leaflet branches about every 12 inches up the stem. You also can tie the cord to the stake 2 to 3 inches above a leaflet branch, then loop the cord loosely around the main stem and tie it to the stake below the branch.

Tomatoes also can be supported by enclosing them in cages constructed of wire or wood. The size of the cage varies with the type of plant. A cage 4 to 5 feet tall and 14 to 18 inches wide will support most plants. Nearly indestructible cages can be made from concrete reinforcing wire mesh. The 6-inch square openings make it easy to harvest even extra-large fruit. For a cage 18 inches in diameter, cut the wire in 4.75 feet lengths and form each into a circle. To make cages of other diameters, use the formula for the circumference of a circle. Bend the end wires to hold the cage together.

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Formula for the circumference of a circle

(2 x 3.14 x r) where r is the radius
-or-
(3.14 x d) where d is the diameter

If you use another type of wire mesh, make sure the openings are large enough for your hand to fit through while holding a large tomato fruit. Place the cages over the young plants and stake the cage to the ground to guard against wind damage and breakage. Electric fence posts make sturdy, inexpensive stakes. Check the plants weekly and adjust the main stem so it grows inside the cage and not through a side opening. Some gardeners wrap nylon netting around the outside and secure with clothespins or clips to eliminate the need to train the stems. The net can be removed once the plants fill the cage.

As the plants grow, remove the "suckers" or side branches and tie the main stem to the stake *(Figure 1)*. Be careful to remove the suckers and not the fruiting stems or leaflet branch. Suckers appear at the point where the leaflet branch joins the main stem. Do not remove suckers from cultivars with a strongly determinate growth pattern.

Figure 1. Remove plant “suckers” as the plants grow.

HAIL PROTECTION

If your garden tends to be damaged by hail, you can reduce the injury to your tomato plants by covering the top of each cage with half-inch hardware cloth. Place a square of the wire on top of each cage and bend the corners down to secure. Using both nylon netting and hardware cloth greatly reduces hail damage from early summer storms.

WEED CONTROL

Weeds compete with tomato plants for sunlight, nutrients and water. In the average garden, weeds are best controlled when small with cultivation or with mulches. Weeds can be removed by hand or with a hoe or cultivator. Cultivating too deeply may damage tomato roots and bring weed seeds to the surface for germination. In large plantings, herbicides can be used.

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Mulches help keep weeds down, reduce water loss and help stabilize soil temperature. Inorganic mulches, such as polyethylene, paper and newer types of fabric, are available in most garden stores or from mail order garden supply companies. Organic mulches, such as straw, leaves or grass clippings, can also be used.

Spread organic mulches at least 2 inches deep on the soil surface. Mulching the soil too early in the spring with organic mulches keeps the soil cool, resulting in slow growth and shallow rooting. Inorganic plastic mulches increase soil temperature and promote earlier growth and production. Keep young stems from touching the plastic, however, as it can become hot enough to burn them on a sunny day. Be sure to water tomatoes adequately during the summer to prevent wide variation in soil moisture. Although mulches reduce evaporation from the soil immediately around the plant, a large, well-established tomato plant may use several gallons of water a day.

HARVEST

Harvest fully ripe tomatoes to get the best flavor and color. Fully ripe tomatoes may be refrigerated for several weeks, although flavor will deteriorate. Nearly mature fruit ripens if stored at 60ºto 70º Do not place immature tomatoes in the refrigerator as this will prevent ripening and flavor development.

In the fall, just before frost or a light freeze, pick green tomatoes for later ripening or pickling. Remove the stems and discard any damaged or diseased fruit. Wipe the tomatoes clean, let them dry and wrap loosely in paper and place on a tray in a cool (not under 50º, unlighted area. Make sure the tomatoes are not touching. When the fruit starts to turn light pink, remove the wrap and allow it to ripen at room temperature.

PROBLEMS

Tomatoes are subject to a number of problems including diseases, insects and environmental stress.

Many tomato diseases, such as septoria leaf spot, early blight, late blight and anthracnose fruit spot, can be controlled or minimized by chemical sprays and sanitation. Reduce fusarium and verticillium wilts by planting wilt-resistant cultivars and rotating crops. Remove diseased plants immediately to reduce future disease problems.

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Blossom drop, a common problem, rarely persists through the season. Blossom drop is caused by, 1), low spring temperatures, usually below 60º 2), high summer temperatures, especially daytime temperatures above 85ºor, 3), nighttime temperatures above 70º or excessive nitrogen fertilization.

Low temperatures reduce pollen production and viability. In some cases, spring blossom drop due to low temperatures may be prevented with a fruit set hormone. The easiest solution is to wait for later flowers to set fruit. Row covers can be used to encourage earlier fruit set by increasing temperatures around the plant.
High temperatures also can reduce flower development and pollen viability. High temperature, especially if accompanied by low humidity and moisture, hinders fruit set through pollination and/or fertilization failure. The adverse effect of high daytime temperature on flower formation and fruit set is somewhat mitigated when night temperatures are within the optimal range of 59ºto 68º.

Fruit cracking is common in home gardens. Heavy moisture following dry periods may cause fruit cracking. Some cultivars crack more easily than others. Mulching plants to help maintain uniform soil moisture levels helps reduce cracking. To minimize cracking during stress periods, pick pink fruits and let them ripen indoors.

Leaf curl commonly occurs in hot weather or after cultivation. Keep plants adequately watered. Deep cultivation around the plants can damage roots and cause wilting. Some cultivars have naturally curling leaves even when not stressed.

Herbicide damage may develop if even a slight amount of a hormone-type weed killer, such as 2,4-D, is used in the vicinity. Curling, twisting and abnormal leaf and stem growth are common symptoms. Avoid using weed sprays close to the garden. If herbicide damage is slight, plants usually return to normal after several weeks.

Walnut wilt of tomatoes may develop if tomato plants are grown too close to black walnut trees. The plants wilt and the lower portions of the stems brown internally. A root rot occurs at about the time of death. The plant injury is caused by juglone, a substance produced by the roots of walnut trees. The injury may not occur every season. To minimize this problem, locate tomato plants at a greater distance from the base of black walnut trees than the tree height.

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Blossom-end rot of tomatoes results from an irregular or insufficient supply of moisture and/or not enough calcium in the fruit. Indications of blossom-end rot are that the tips of tomato fruits, especially the first fruits to ripen, become water-soaked, turn light brown in color and become sunken as the fruits enlarge and begin to ripen. To reduce this condition: mulch to maintain uniform soil moisture; do not cultivate deeply around the plant; and avoid using high-nitrogen fertilizer. Disease organisms are not responsible for blossom-end rot, so fungicides are of no value in its control.

Laurie Hodges and Dale T. Lindgren, Extension Horticulture Specialists
Susan Schoneweis, Extension Coordinator - Home/Environmental Horticulture

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CHAPTER 3

SPECIALTY CORN

IN THIS CHAPTER, YOU WILL LEARN:

- All about the various types of corn
  - Sweet corn
  - Popcorn
  - Hi-Lysine corn
  - High-Oil corn
  - Waxy endosperm corns
  - Blue corn
  - Corn cob corns

SPECIALTY CORN

United States Department of Agriculture
Cooperative State Research Service
Office for Small-Scale Agriculture

Five hundred years ago, Columbus was one of the first Europeans to set eyes on maize-foundation of most great Western Hemisphere civilizations, including those of the Incas, Mayans, and Aztecs. In the April 1992 Organic Gardening magazine, Shepherd Ogden says, "sweet corn is the most American of vegetables." His article has tips for growers.

In 1540, Coronado noted maize or corn growing under irrigation among Native Americans of the southwestern part of what is now the United States. Corn largely kept the Pilgrims alive during the harsh winter of 1620 on the East Coast. The oldest known remains of corn cobs may be in Tehuacan, Mexico, dating back 7,000 years. Most corn historians consider a wild grass called Teosinte one of modern corn's primary ancestors.

Corn is one of the most diverse grain crops. Nature by itself and man working with it have produced many types of corn. Corn is generally classed as to kernel endosperm characteristics. Endosperm refers to a seed's nutritive tissue, surrounding and absorbed by the embryo. The six most common corn types include flint, flour, dent, pop, waxy, and sweet. A seventh is called pod or tunicate corn, which may have endosperms like the other six. Pod corns differ from the others in that each individual kernel Is enclosed in a glume or husk.

Popcorns are basically small-kerneled flint types. Waxy corn carries a gene which results In the production of 100 percent amylopectin, i.e., starchy pectin.

SWEET CORN

Standard sweet corn at the immature, milky stage contains about 10 percent sucrose, while field corn in the same stage has about 4 percent. After harvest or if left on the stalk too long, sucrose in standard sweet corn is rapidly converted to starch.

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Unlike dent corn, sweet corn is not grown for feed or flour, although USDA researchers have developed a technique to produce a high-fiber, no-calorie flour from pericarps that surround kernels, holding them on the cob.

Sweet corn kernels often have a wrinkled, glassy appearance resulting from a sugary gene which retards the normal conversion of sugar to starch during endosperm development. Kernel colors vary, sometimes being mixed both white and yellow.

William "Bill" Watson, president and owner of the Liberty Seed Company (P.O. Box 806, New Philadelphia, Ohio 44663; 1-800-541-6022 or 216-364-1611), is doing a write-up of the many sweetcorn developments of the past decade. He says there has been more change in the past decade than in the preceding 25 years.

To compete and find a nearby niche (like a restaurant or roadside stand) for their sweet corn, entrepreneurs should explore the potentials for moving high-sugar varieties of corn to consumers within a day after harvest. The need for speed is because kernels at room temperature can lose as much as 50 percent of their sucrose by 24 hours after harvest.

Development of sweeter varieties of standard sweet corn was done by selections within homozygous "SU1" genotypes. One selection-SiIver Queen-became the standard against which other standard sweet corn varieties were compared. Later supersweet SH2 varieties, i.e., "sugary enhanced (SE)" or supersweet "shrunken (SH2)," have 2 to 3 times as much sucrose as standard sweet corn at harvest! What's more, sucrose levels stay relatively high 48 hours after harvest.

Growers of the SH2 gene sweet corn must be careful not to plant it within 250 feet or more-depending on prevailing winds-of any other kinds of corn because pollen may be picked up from neighboring corn, which will dilute the sweetness, making kernels undesirably tough and starchy.

One exception to the distant planting rule is Kandy Korn, whose sugar-enhanced SE gene produces a variety for farmers that, like other SE varieties, requires no isolation. (Abbott and Cobb, Inc.; 1-800-345-SEED. Asgrow; 616-323-4000).

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Growers for the roadside trade usually sell high-sugar corn of the SE variety because it's easier to grow; those who ship to the more distant markets lean toward the supersweet varieties to meet the competition.

The seed count is about 2,500 to 3,500 a pound for regular sweet corn. The count of the shrunken gene types is considerably higher. Andy and Tannie Daniels are successful sweet corn growers at Route 4, Box 73, Columbus, NE 68601. Their story is reported in *Successful Farming Magazine's* publication, *ADAPT 3, 1991*. (P.O. Box 10652, Des Moines, IA 50309-3023, $12.50. 515-284-2852).

The Daniels note that roadside stand work is hard, the season is not long, and the returns may grow slowly. To pick corn at the peak time, they usually pay high schoolers or others the minimum wage. Roadside prices for sweet corn vary widely. Discounts for quantity are urged. The freshness increases the value (price) over grocery store pricing. Don't undercut grocery stores. The Daniels also advise adding other vegetables, such as tomatoes and cantaloupe, after establishing a customer base.

They recommend SE varieties over the others for reasons noted above, plus disease control. The sweeter the variety, the more susceptible it is to disease, usually. The Daniels say plant early, with not too many varieties so as to avoid confusing customers.

Growers should check with the county agriculture Extension agent to learn the best planting dates, varieties recommended locally, and disease and pest control methods that reduce or eliminate chemicals. The supersweets are just as good for freezing as the others. There are many varieties. Every catalog will have some.

Other marketing details have been emphasized in previous factsheets and are in the ADAPT books and not repeated here. It needs repeating, however, that entrepreneurs not wishing to waste money should determine an exact and committed market before they buy or plant any seed.

POPCORN

Popcorns are generally either pearl or rice types. Pearls have smooth, rounded crowns, while rice types are pointed. Color varies. Heating the kernel turns the moisture inside the soft starch in the center into explosive steam that can turn the kernel inside out. The

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greater the expansion, the higher the quality. Moisture content should be 13.5 to 14 percent for best results. Varieties differ as to quality, which also includes flavor, tenderness, absence of hulls, color, and shape.

Shape can vary from mushroom-spherical to butterfly. The confection industry usually prefers the spherical-easier to coat with flavors or syrups. The butterfly-shaped popcorn has a better "mouth feel" and is preferred for on-premises sales, as in theaters.

For more information, contact the Popcorn Institute, 401 N. Michigan Ave., Chicago, IL 60611. (312-644-6610).

HI-LYSINE CORN

Corn is a major staple in many underdeveloped countries. As dent corn is a relatively poor source of protein, many consumers have to supplement their diets with other protein sources like beans.
Most of the protein in corn is zein, which cannot be efficiently digested by humans and other nonruminant (single stomached) animals like pigs and chickens. Zein exists at the expense of lysine and tryptophan, which tend to be very low in dent corn. Lysine and tryptophan, two of eight essential amino acids that nonruminants can't synthesize on their own, must be obtained from food they eat.

In 1963, scientists at Purdue University found that the corn strains containing opaque-2 (02) genes contained lesser amounts of zein and greater amounts of lysine and tryptophan in their endosperms than dent corn. Opaque-2 kernels, however, appear dull and tend to have soft textures and very little hard endosperm. It makes them difficult to harvest and subject to attack by various pests. Opaque-2 varieties also tend to have lower yields and must be isolated from other corns to retain protein quality. For more information, contact Crow's Hybrid Corn Co., P.O. Box 306, Milford, IL 60953. (815-889-4151).

HIGH-OIL CORN

The highly polyunsaturated and high linoleic acid content of corn oil makes it an excel-lent energy and essential fatty acid source for both humans and livestock. Livestock feeders may be interested in varieties with greater oil contents. Such varieties have more calories, bringing greater gains per feed unit.

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Most hybrid dent corns will average between 3.5 and 6.0 percent oil. Varieties with oil contents greater than 6.0 percent and tend to have lower yields.

Oil quality is dependent on the amounts of unsaturated and saturated fatty acids it contains. Oils high in linoleic acid and low in oleic, palmitic, and stearic acids are preferred for human diets. For information on breeding high-oil corn, contact John Dudley, Agronomy Department, S-112 Turner Hall, 1102 South Goodwin Avenue, University of Illinois, Urbana, IL 61801. (217-333-9640).

WAXY ENDOSPERM CORNS

Waxy endosperm hybrids contain 100 percent amylopectin starch; the normal dent corn ratio is 72 percent amylopectin and 28 percent amylose. The waxy (wx) mutant was found in China in 1909 but was not fully developed until 1936 when researchers from Iowa State University noted its unique properties and started developing hybrids. Steers make better gains when fed waxy endosperm corn rather than dent corn. The stability and clarity of amylopectin starch make It highly suitable as a food thickener. For more information on food processing aspects, contact Edith Munro, Corn Refiners Association, 1100 Connecticut Avenue NW., Suite 1120, Washington, DC 20036. (202-331-1634).

BLUE CORN

Atole, tortillas, corn chips, and other corn products have been the backbone of most traditional and present-day Native American and Mexican American cuisines. Blue corn and other flour corns historically represented the major kernel type of corn ground into "harinas" (flour and meals) in the American Southwest. But dent corns, both white and yellow, now dominate the market. However, the blue corns are finding new market outlets.

Although Pueblo tribes have historically grown many different colored corns, blue corn is one of the most important, both as food and for religious purposes.

Unlike most commercial yellow hybrid dent corns that can yield 8,000 to 10,000 pounds of grain per acre, blue corn is open-pollinated and characterized by relatively low yields of 1,000 to 4,000 pounds per acre. It also tends to lodge, making machine harvest somewhat difficult.

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Blue corn has a coarser, sweeter, and nuttier taste than other corns grown for flour or meal. Its grainier consistency results in a somewhat denser tortilla than those made from white or yellow corn flour.

Research of the New Mexico Cooperative Extension Service found blue corn, like Opaque-2 corn, higher in lysine than either white or yellow dent corn varieties used in tortillas. Most blue corn varieties were also found to be high in iron and zinc.

Blue corn flours and meals have traditionally been used in making tortillas and corn chips. Native American products less well known include piki or paper bread, chaqueque (similar to corn meal mush), atole (corn meal drink), and nixtamal or lime hominy used in making stews.

Newer products include pancake and muffin mixes and corn flakes. For more information, contact George Dickerson, New Mexico Cooperative Extension Service, address below. (505-275-2576). Seed source: Rose Seed Company, San Jon, NM 88434. (505-576-2241).

CORN COB CORNS

Although most corn grown in the United States is for grain or silage, at least one hybrid variety is grown for making corn cob pipes. Cobs should be at best 1/12 Inches in diameter and long enough to make at least two bowls (2 Inches each). The diameter of the cob should be relatively uniform.

Cobs should be woody and sufficiently hard to keep smoking tobacco from burning through the bowl. For more information, contact Harry Minor, the Agronomy Department, Extension Service, Waters Hall, University of Missouri, Columbia, MO 65211. (314-882-2001)

Prepared by George Dickerson, Extension Horticulture Specialist, New Mexico Cooperative Extension Service, 9301 Indian School Rd. NE, Suite 201, Albuquerque, NM 87112 and George B. Holocomb of the Office of Public Affairs, U.S. Department of Agriculture, for USDA's Office for Small-Scale Agriculture (OSSA); Howard W, "Bud" Kerr, Jr., Program Director. OSSA's address: Cooperative State Research Service, USDA, Room 328-A, Aerospace Building, Washington , DC 20250-2200. Telephone: 202-401-1805; Fax: 202-401-1804.

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CHAPTER 4

KALE: THE "NEW" OLD VEGETABLE

IN THIS CHAPTER, YOU WILL LEARN:

- A little bit of the history of kale
- About the various types of kale
- The best growing techniques

Kale: The "New" Old Vegetable

Kale is the one of the oldest forms of cabbage, originating in the eastern Mediterranean. Kale is thought to have been used as a food crop as early as 2000 B. C. Theophrastus described a savoyed form of kale in 350 B.C. Travelers and immigrants through the ages have introduced this green vegetable to many parts of the world.

The curly leaves of kale are among the most nutritious vegetables. One 3.5-ounce serving of kale provides all the adult daily requirement of vitamin A and C and 13 percent of the calcium requirement. Kale is used as a green vegetable, steamed and served with butter or vinegar, or in soups. Much of the present production is used as decoration on salad bars since kale is less likely to wilt than lettuce or other greens.

Kale is tolerant of cold temperatures and is especially sweet following a light frost. Production is mainly from Norfolk, Virginia to Long Island, New York where it can be spread over a long, mild winter season. Smaller production areas are scattered throughout the U. S.

Cultivars of kale differ primarily in leaf color and texture, but selections and availability are limited. Scotch types have extremely curled, wrinkled, and finely divided leaves with color ranging from bright green to yellowish-green. Varieties include Dwarf Green Curled Scotch, Dwarf Blue Curled Scotch, and Tall Green Curled Scotch. Hybrid kale such as Blue Knight, Blue Armor, and Winterbor tends to be more uniform in plant size, leaf texture, and the preferred blue-green color. Blue-green color is commonly associated with greater cold tolerance. Smooth-leaf Siberian kale (Hanover salad) is not commonly grown. Some specialty seed dealers sell Red Russian kale, an heirloom cultivar with wavy leaves. The veins and stems of Red Russian are blue-green in warm weather but turn red in cold weather. Varieties sold as "flowering kale" are used as ornamental plants or for decoration. Although edible, it is not as palatable as regular kale. Seed of "flowering kale" is available through flower seed dealers rather than vegetable seed dealers.

Kale can be transplanted, but most of the production is direct-seeded into heavy, friable loam soils. These soils, with a pH of 6.5 to 6.8, produce the heaviest yields and are preferred. As with cabbage, kale is a heavy feeder. For a yield of 1000 lbs/A of greens, suggested fertilizer rates are 40, 12, and 40 lbs/A of actual N, P, and K banded under the seed followed by a side-dressing of 15 to 30 lb/A of N approximately 1 month after seeding. Seeding is usually 1/4-inch

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deep, with 6-inch in-row spacing and up to 36 inches between rows. For smaller gardens, a closer in-row spacing is possible with the thinnings used as an early crop. Home gardeners may harvest only the more mature outer leaves allowing the plant to produce new leaves throughout the spring or fall. Commercially, the crop is produced for a one-time harvest about 40-55 days after planting with sequential plantings at 2-week intervals to provide continuous supply for the market. Quality deteriorates when temperatures exceed 85 degrees. For an early spring crop of kale, you can begin sequential seedings when soil temperatures reach 45 degrees. For a fall crop, plantings can be made in late July and August. Although kale flavor improves with frost, plants should be almost market size before cold weather.

Leaves should be young and tender at harvest. After harvest, the leaves are washed, graded, and either bunched or packed. Containers include bushel baskets, crates, and cartons (12 or 24 bunches), or wirebound crates. For local distribution, ice may not be necessary. All long-distance shipping requires ice to preserve freshness. Kale can be stored for 10-14 days at 32 degrees and 90-95 percent relative humidity.

Pest and disease problems are similar to those of cabbage.

Laurie Hodges, Ph. D. Extension Specialist Commercial Vegetable Production

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CHAPTER 5

PEPPERS

IN THIS CHAPTER, YOU WILL LEARN:

- About the various aspects of “Sweet” and “Ornamental” peppers
- How to grow your own transplants or purchase them
- How to properly transplant into the garden
- The proper growing techniques for a bountiful harvest

Peppers

G81-540-A (Revised May 1990)

Peppers are treated as warm-season annual crops when grown in the home garden. They are related to eggplants, potatoes and tomatoes, all of which belong to the Solanaceae (Nightshade) family.

Garden peppers (*Capsicum annuum*) include different strains commonly called sweet peppers, chili peppers and Hungarian peppers. They are quite different and not in the same genus as the plants that furnish the black pepper (*Piper nigrum*) used as a condiment. Tabasco peppers (*Capsicum frutescens*) are the small fruited peppers generally processed into hot sauce, which are largely grown in warmer climates.

Garden peppers usually are classified as sweet (mild) or pungent (hot). They are available in various shapes, sizes and colors. Fresh peppers are high in vitamins A and C.

Although peppers are mainly raised for human consumption, they can be grown as ornamentals in containers, or outdoors among flowers. The skin color of peppers include yellow, orange, red, green and purple.

SWEET PEPPERS

Sweet peppers may be blocky, round or tapered. They are mild in flavor and generally thick-walled. The flesh usually starts out green and changes to red as the fruit ripen. Certain varieties, or cultivars, change from yellow to green or green to yellow as they ripen.

Blocky (bell) types are the most popular for home garden use. They are convenient for stuffed peppers and for use in pizzas, salad and for eating fresh. The sweet yellow peppers, which include banana types, and the small cherry peppers used mainly for pickling, also perform well in the home garden.

A list of recommended pepper varieties include Ace Hybrid, Bell Boy, California Wonder, Dutch Treat, Golden Bell and Yolo Wonder.

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PUNGENT PEPPERS

Pungent or hot peppers vary from mildly pungent to very hot in taste. They are most commonly used in making chili or similar dishes, and are canned or dried.

In general, the 'green-turning-red' types are more pungent than those that are 'yellow-turning-red.' Recommended cultivars include Hungarian Yellow Wax, Jalepeno, and Large Red Hot. Other varieties also perform satisfactorily.

Use care in handling the fruit of hot peppers. Volatile oils in the fruit can irritate and burn if they come in contact with the skin or eyes.

Wearing protective rubber gloves is the best method to prevent skin contact with hot types of peppers. Washing your hands with soap and water after handling these peppers helps reduce irritation. Avoid letting your hands come in contact with your face, especially around your eyes and lips.

ORNAMENTAL PEPPERS

Ornamental peppers are increasing in popularity, especially as potted plants during the holiday season. Plants are available in many forms, and have small fruits of various shapes and colors. They are usually purchased when already in fruit.

In the home, the potted plants should be kept in a well-lighted location, and the growing medium kept uniformly moist. The ornamental pepper usually requires no fertilizer once it is in fruit.

Although the fruits usually are edible, ornamental peppers often are treated chemically to control pests. In general, it is recommended the fruit not be eaten.

PURCHASING TRANSPLANTS

Most home gardeners find it more convenient to buy their pepper plants rather than to grow their own from seed due to insufficient space, lack of time, and inadequate growing conditions. When purchasing plants, select those that are sturdy, dark green in color and not yet in bloom. Leaves should be fully expanded and free of disease and insects.

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Transplants are available in packs of six to eight, in flats of several dozen, or in individual containers. Those in individual containers are transplanted with the least amount of shock because the roots are not disturbed when they are set out in the garden. Plants grown in individual containers may cost more, but they usually are worth it.

GROWING TRANSPLANTS

When growing your own pepper transplants, sow the seeds six to eight weeks before the plants are to be set in the garden. The seeds may be planted into small pots, growing containers or flats, and later transplanted into individual growing containers.

Seeds can be germinated directly in individual containers without transplanting to other containers. Pots with more than one seedling should be thinned to a single plant.

Various commercially prepared mixtures for starting seeds are available. These are generally easier to use than preparing your own mix because they do not require the preparation.

You can make your own soil mix for germinating seed by combining two parts garden loam soil, one part sand, and one part peat (by volume). Both the container and soil mix should be sterilized before use. This can be done by placing them in an oven and heating for 30 minutes at 180°F. Use only those containers that will not melt or catch fire.

Previously used plastic containers, which may harbor diseases, can be reused by disinfecting them in a 5 percent solution of bleach for 20 minutes.

Cover the seeds with 1/2 inch of soil. For good germination, keep the soil moist and at a temperature of 70 to 80° F.

Covering the flats or pots with a sheet of plastic or pane of glass helps maintain the proper moisture and temperature. When the germinating seeds break through the soil surface, remove the cover and water the soil only as necessary to keep it moist to the touch.

Transplant young seedlings into growing containers when the stems have straightened and the first true leaves have opened. This is usually 15 to 20 days after the seed was sown.

When transplanting young pepper seedlings, hold the plant by one of the leaves. Pressure on the stems can cause permanent damage.

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Young plants should be exposed to full sunlight, if possible. Artificial light may be necessary if adequate sunlight is not available. The best temperatures for growing transplants are from 65 to 80°F during the day, and 60 to 70°F at night. Growing the plants in a hotbed or cold frame works well.

TRANSPLANTING TO THE GARDEN

Pepper plants require more care than many other types of plants when transplanting them to the garden. Hardening the plant enables it to withstand the planting shock. The hardening process should begin 10 days to two weeks before planting peppers in the garden. To start the hardening process, move plants in their containers outdoors to a shady spot. A cold frame works well for this purpose.

Move the plants into sunlight for short periods each day, gradually increasing the length of exposure. Reduce the frequency of watering to slow growth, but don't allow the plants to wilt. Do not put tender seedlings outdoors on windy days.

Transplant the pepper seedlings outdoors when 1) the soil temperature is above 55°F, 2) the risk of frost is low, and 3) the plants have been hardened.

The frost free date varies from year to year and location to location. Some years you can get by with an earlier planting date than in others.

Protect the plants with paper or plastic covers (hotcaps), newspapers or boxes if there is danger of frost.

Set the plants slightly deeper in the soil outdoors than they were growing in the container, especially if they are leggy. If plants are in peat pots, tear back the peat on one side of the pot. Press the soil firmly around the plant so a slight depression is formed to hold the water. Water the plants immediately.

Distances between plants depend on the variety used. In general, set the plants 18 to 24 inches apart in rows 3 feet apart.

Pepper plants should not be topped at transplanting time. Topping removes the area of first flower buds and delays first fruit set and fruit harvest.

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PLANTING SITE

Plant pepper plants in full sun. Plants growing in partial shade produce less than optimum yields and take longer to produce ripe fruit.

The site should have fertile, well-drained soil. Individual plants may be grown in large containers, but these plants need more attention as the soil tends to dry out quickly.

SOIL PREPARATION AND FERTILIZATION

Garden soils can be tilled or spaded in the fall after the harvest season, or in the spring before planting. Soil should not be worked while it is wet.

A soil test may be necessary to determine the fertility of your soil. If soil nutrition is low, apply 2 to 3 lbs of a complete fertilizer (ex: 5-10-10, 6-12-12, or 9-16-16) per 100 square feet of garden area when preparing the soil.

A side dressing of 1/4 cup fertilizer in a 2 foot circle around the base of the plant immediately after flowering may be beneficial on soils low in nitrogen. Excessive nitrogen fertilizer tends to force the plants to produce too much foliage and little fruit. Do not over-fertilize.

WATERING

Peppers need about one to two inches of water each week. This varies according to temperature, type of soil, rainfall and whether or not a mulch is used. Sandy soils require more frequent watering.

Heavy soakings at weekly intervals are better than many light soakings as light, frequent waterings promote shallow root systems. Mulching reduces water loss from the soil.

WEED CONTROL

Weeds compete with pepper plants for sunlight, nutrients and water. In the average home garden, weeds are best controlled with cultivation or mulches. In large plantings, herbicides can be used.

Mulches help keep weeds down, reduce water loss and stabilize soil temperatures. Inorganic mulches, such as polyethylene, are available in many garden stores.

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Organic mulches such as straw, leaves or dried grass clippings (burying roots in 3-4 inches of green grass clippings can damage the plants) also can be used. Organic mulches should be at least 2 inches deep and preferably 3 to 4 inches deep.

Mulching the soil too early in the season with organic mulches keeps the soil cool, resulting in slow growth and poor fruit set. It also can cause shallow rooting. Inorganic plastic mulches, however, increase soil temperatures and promote earlier growth and production.

HARVESTING

The average yield of pepper plants varies with the variety planted. Bell peppers produce less fruit per plant (seven to 10), but larger fruit than other types.

Pepper fruit usually are picked when they have stopped increasing in size and are firm to the touch. Sweet peppers are generally harvested when they are full-sized, but at an immature stage before they ripen to their final color. Fruit left on the vine until completely ripe reduces the total productivity of the plant. However, many individuals enjoy the ripe red, yellow, or green ones, as well as the immature ones.

Cutting instead of pulling is recommended when harvesting pepper fruit from the plant because the branches are brittle and can break easily.

Total yields have been reported to be improved when fruit is harvested without waiting for the peppers to grow to full size. Hot varieties are harvested either immature (green or yellow) or mature (red) for pickling, canning, fresh use or dry seasoning.

PROBLEMS

Peppers are subject to a number of problems. These include diseases, insects and problems brought on by weather and other environmental factors.

Blossom-end rot of peppers usually results from an irregular or insufficient supply of moisture. This problem is characterized by small areas at or near the tip of pepper fruit that become light brown and sunken. They develop a leathery texture as the fruit reaches full size. It is usually more of a problem on the first fruit.

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Mulching helps avoid this condition. Avoid frequent light waterings.

Parasitic disease organisms are not responsible for blossom-end rot, so fungicides are of no value in its control.

Poor fruit set in peppers can be caused by a number of factors. Certain varieties may fail to set early fruit more frequently than other types.

Poor fruit set can be caused by plants being stunted from being too old when transplanted, having been too dry sometime before or after planting in the garden, too much nitrogen fertilizer, and either too low (less than 55°F) or too high (above 75°F at night or 90°F during the day) temperatures in the garden. Fruit set usually occurs when milder conditions return. Large-fruited types tend to drop many of the flowers that form after several fruits have started to develop on a plant.

Sunscald on pepper fruit is caused by exposure of the fruit to direct sunlight, especially after being shaded by foliage. Sunscald is characterized by a light-colored area that becomes slightly sunken, with a papery appearance. Keep the plants vigorous and healthy so leaves do not wilt excessively, and foliage protects the fruit from direct sunlight.

Insects occasionally are a problem on peppers. Cutworms may feed on new leaves or cut the stems on small plants.

Diseases of peppers include seed rot, damping off, virus infection and bacterial spot. Seed treatment and proper growing conditions can reduce seed rot and damping off. Mosaic, a virus disease, can be avoided by growing mosaic resistant varieties.

Dale T. Lindgren, Extension Specialist/Horticulture
Laurie Hodges, Extension Specialist/Horticulture

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CHAPTER 6

SPECIALTY MUSHROOMS

IN THIS CHAPTER, YOU WILL LEARN:

- All about the various features of mushrooms
- Specific information about various “popular” culinary mushrooms
- Where to get additional information relating to the culture of mushrooms

Specialty Mushrooms

United States Department of Agriculture
Cooperative State Research Service
Office for Small-Scale Agriculture

If you enjoy cultivating the unusual, specialty mushrooms offer many possibilities. The term "specialty" refers to any mushroom, except the white button mushroom commonly found in supermarkets.

Specialty mushrooms include shiitake, oyster, enoki, wine cap, maitake, and pompom among many others. Selling large quantities of any of these mushrooms may be a challenge unless you are near a large ethnic population (e.g., Asian American) that has enjoyed these delicacies for centuries. Smaller quantities can be sold locally in farmer's markets as part of a pick-your-own fruit and vegetable operation, to gourmet restaurants, to health food stores and to local grocery stores. While production of the common button mushroom is a possibility, it is already widely available in grocery stores, and new growers will be competing with large-scale producers in established markets. However, small-scale cultivation of specialty mushrooms could be a profitable addition to a farming enterprise.

ABOUT MUSHROOMS

A mushroom is neither a plant nor an animal, but has properties of each. Modern taxonomists give the fungi, including all mushrooms, a kingdom all their own. Most mushrooms have a "common" name and a "scientific" name. The latter identifies the genus, species, and sometimes the variety of mushroom for the experts. This eliminates confusion since one common name can apply to several different species. Scientific names usually appear in italics with the genus capitalized.

Like plants, mushrooms begin with a "seed," which is actually a microscopic spore. The gills or pores beneath the cap of a parent mushroom produce spores and a single mushroom produces thousands. The wind can easily transport a spore until it comes to rest in a suitable environment and then germinates and grows into a mat of root-like filaments called hyphae. The mat of hyphae is called the mushroom's mycelia. Unlike plants, this outgrowth of a single spore cannot produce a mushroom. Instead, like animals, a sexual

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union is necessary. In mushrooms, that union occurs when a hyphae from one spore contacts a hyphae of a compatible spore. After joining, the mycelia is capable of producing mushrooms, the fruit of the fungi.

Mushroom cultivators typically use already growing mycelia called spawn, rather than growing their mushrooms from spores. The spawn can be purchased from several sources or produced in-house on grain. When the spawn is ready to use, each grain kernel has enough living mycelia to begin mushroom growth when introduced to the growing medium or "substrate."

Environmental conditions are the key to cultivating mushrooms. The hyphae may not grow if the substrate is not correct. If nutrients are not sufficient or the weather is not appropriate, healthy mycelia may not bear fruit. Some mushrooms will produce fruit under a wide range of conditions while others are very specific in their needs.

Some even require a symbiotic relationship with specific tree species before they will fruit. Mushroom cultivators must understand the requirements of the species they want to grow. After identifying environmental needs, the grower determines whether to grow a particular species outdoors or in a controlled environment. Typically, investments in climate- controlled rooms will be much greater than investments in outdoor growing space. Mycologists are regularly discovering ways to cultivate new species. Let's look at the attributes of a few specialty mushrooms and their requirements.

SHIITAKE (LENTINULA EDODES)

Shiitake mushrooms are very popular in Japan. American production of shfitake has increased faster than any other specialty mushroom. Until recently, worldwide production of shiitake was second only to the common button mushroom. Shiitake grow best with certain hardwood species, especially ironwood and oak. Other substrates with a corncob or straw base and several additives can produce shiitake, but have not proven as good a substrate as the hardwood species. Depending upon the climate, shiitake may grow on logs outdoors. Indoor growers typically use a substrate composed of sawdust and several additives. Current wholesale market prices for shiitake range from $3.50 to $8 per pound, depending upon quality and size. Growers typically get from $4 to $6 per pound for their best mushrooms.

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OYSTER (PLEURATUS SPP.)

There are several species of oyster mushrooms that are widely cultivated internationally. Major production increases in China recently moved the oyster mushroom to second place in terms of worldwide production. Some of the more common species include the Indian oyster, tree oyster, golden oyster, pink oyster, and the abalone mushroom.

Unlike the shiitake mushroom, oyster mushrooms grow prolifically on a variety of substrates including most hardwoods, paper, cereal straws, coffee grounds, corncobs and sugarcane bagasse, among many others. If you have an agricultural or wood waste product in your area, you can probably find a variety of oyster mushrooms that will grow on it.

Oysters are most commonly grown indoors in specially constructed growing rooms, which sustain the necessary climatic conditions. They need high humidity and warm, not hot, temperatures. Many growers convert existing barns, stables or sheds, or buy an inexpensive greenhouse that can be insulated. Humidity is provided via misters or commercial-scale humidifiers. Heating comes from whatever inexpensive source is readily available. Most mushrooms, including oysters, require light during their life cycle and daylight fluorescent bulbs seem to work well.

Other mushrooms require a sterilized substrate. A boiler and an autoclave large enough to sterilize commercial quantities of substrate are quite expensive. Oyster mushrooms are so prolific that the mycelia outgrows most contaminants. Thus, pasteurization is generally sufficient. For a chopped straw substrate, pasteurization can be accomplished in a hot (160o F) water bath for a couple of hours. After cooling, the spawn is mixed with the straw. One technique for growing oysters uses plastic bags fro a roll of tubing usually 8 to 14 inches in diameter. The grower cuts a length of tubing, ties a knot in one end and stuffs the inoculated straw into the bag. When the bag is nearly full, a knot is tied in the other end and the bag is hung in the growing room. Holes ar punched in the bag to allow the mycelia to breathe and to provide a place for the mushrooms to pop out.

Oyster mushrooms have several advantages and only a few drawbacks. They are easy to grow using agricultural waste as a substrate. If straw is used as a substrate, the remaining composted material can be used as a feed for cattle or hogs or as a soil amendment after the mushrooms are harvested. On the cautionary side, oysters produce numerous spores which trigger allergies in

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many people. Usually a respirator is required for lengthy stays in the growing room. Marketing opportunities may be limited since oysters have a relatively short shelf life of approximately 1 week. Finally, they attract mushroom gnats more than most other species. Current wholesale prices range from $2 to $4 per pound.

KING STROPHARIA OR WINE CAP (STROPHADA RUGOSO-ANNULATA)

This mushroom is good for outdoor growing. It can be easily cultivated in a shady bed of hardwood chips and/or straw. Some gardeners use beds in cold frames to produce crops from summer to fall. These mushrooms grow to enormous size, weighing 5 pounds or more. Unfortunately, these huge specimens are usually filled with fly larvae and unsuitable for human consumption. However, the larvae infested mushrooms do make great fishfood! Obviously, the younger mushrooms are the desired edible for people.

Since these mushrooms have not been widely commercialized, there is no established market. However, there is the opportunity to combine stropharia with other products of a small farm for sale at a farmer's market or vegetable stand. Expect prices in the $5 per pound range. They also have the advantage of turning your waste woodchips or sawdust into a rich compost while providing mushrooms for several years.

SHAGGY MANE (COPRINUS CORNATUS)

The shaggy mane is not typically produced on a commercial basis as it becomes an undesirable mass of black ink within a few hours of harvesting if it is not cooked immediately.

Inclusion in a pick-your-own operation may be profitable if customers are carefully taught how to handle this species.

The main advantage is that it is easy to grow and you may already have some growing wild on your farm. It even shows up as a contaminant for growers of other mushrooms, like the oysters. To encourage its growth, you need only inoculate a bed made up of a soil/sawdust, manure/sawdust, or straw/manure mixture and keep it wet. Research from China indicates that this mushroom may suppress the growth of certain types of cancers.

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MAITAKE (GRIFOLA FRONDOSA)

The maitake-or hen-of-the-wood-is different. It comes from a group called the polypores. Rather than distinct individuals, this mushroom produces a large clump of interwoven "leaves." It grows wild on dead or dying hardwood trees or stumps in the Northeastern and Mid-Atlantic States. Growth can be induced by inoculating a suitable log or stump with its mycelia. An advantage is that the Maitake can recycle old stumps into forest soil. The major disadvantage is the 3 years it may take to produce any fruit.

MORE INFORMATION

This factsheet only hints at the possibilities of growing specialty mushrooms. You may already have delicious species, like some of those mentioned above or common meadow mushrooms or even giant horse mushrooms, already growing on your farm. The details needed for cultivation have not previously been well understood or easily available to the public. Continuing experimentation has led to more accessible information. In addition to the publications that specifically address shiitake cultivation, as noted in the factsheet entitled Shiitake Mushrooms from the Office for SmallScale Agriculture (OSSA), the following selections may be helpful:

For a quick overview of several species: Organic Gardening Magazine - November 1993

For a more detailed discussion on growing many mushroom species outdoors: *"Mushrooms in* the Garden" by Hellmut Steineck. A 152-page book published by Mad River Press. ISBN: 3-8001-6122-2.

For details on both outdoor and indoor cultivation: "The *Mushroom Cultivator* - A Practical Guide to Growing*Mushrooms at* Home, " by Paul Stamets; and J.S. Chilton. A 415-page book published by Agarikon Press. ISBN: 0-9610798-0-0.

For a comprehensive mushroom guide with over 1,000 color photographs:*"Mushrooms* of *North America,"* by Roger Phillips. A 319-page book published by Little, Brown and Company.
ISBN: 0-316-70612-4.

For a monthly update on prices, marketing information, and production techniques: The *Mushroom G*rowers 'Newsletter *P.O. Box 5065 Klamath Falls, OR 97601*

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For more details on more species: "*Growing Gourmet and Medicinal Mushrooms" by* Paul Stamets. A 552-page book published by Ten Speed Press. ISBN: 089815-608-4.

Published monthly, 6 - 8 pages, *$24 annually.*
By Jerry *Haugen, P*. O. *Box 5065, Klamath Falls, OR 97601*

George B. Holcomb (Retired), Office ofCommunications, U.S. Department of Agriculture, for USDA's Office forSmall-Scale Agriculture (OSSA); Howard W. "Bud" Kerr, Jr., Program Director. OSSA's address: Ag Box 2244, Washington, DC 20250-2244.
Telephone: 202-401-1805; FAX: 202-401-1804.

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CHAPTER 7

LETTUCE

IN THIS CHAPTER, YOU WILL LEARN:

- All about the different varieties of lettuce
- The cultural requirements for a bountiful harvest
- Various pest problems
- How to harvest lettuce

Lettuce

G73-71-A (Revised April 1990)

Lettuce is an increasingly popular vegetable in the United States. Because it is a basic ingredient in salads, lettuce is eaten more frequently than any other vegetable. Lettuce can be served alone ("lettuce alone" = "a lovers salad"...poor pun, sorry about that) with a variety of dressings or mixed with other fresh vegetables.

Its fresh color and crisp texture serve well as a garnish, and its leaves may be stuffed with fruit, cheese, seafood, poultry, ham, or egg salads. Although usually consumed fresh, leaf lettuce and chopped green onions "wilted" with warm vegetable oil and vinegar make a pleasing, refreshing springtime dish.

VARIETIES

There are five different types of lettuce: crisp-head, leaf, butterhead, cos or Romaine, and stem.

The **crisp-head varieties** with dense, firm heads and crisp leaves are by far the most important commercial types. Strains of Great Lakes, an All American winner, and Imperial mature about 75 days from planting and withstand warm weather better than other crisp-head varieties.

Black-Seeded Simpson, Early Prizehead, Oak Leaf, Grand Rapids and Ruby Red are **leaf lettuce varieties** that mature about 45 days from planting. In contrast to the bright green leaves of other varieties, Ruby Red, an All American winner, has frilled, glossy red leaves.

Leaf lettuce matures quickly, is easy to grow, and is a good type of lettuce for home gardens.

Butterhead lettuce produces a loose, soft head. The inner leaves have an oily or buttery feel. Butterhead varieties produce high quality lettuce. They mature slightly earlier than crisp-head varieties, and are less tolerant of warm weather.

Big Boston, Bibb, and Buttercrunch, an All American winner, are popular varieties. Butterhead lettuce does best when started early indoors or in cold frames, and transplanted to the garden.

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The **cos** or **Romaine** type of lettuce develops an elongated head of stiff, upright leaves about 80 days from planting. Cos lettuce is important in Europe and is gaining popularity in the United States. Paris White and Parris Island are available varieties. Cos lettuce is more difficult to grow than other types of lettuce.

Stem lettuce often is listed in catalogs under the name of Celtuce (CELery - letTUCE). It is grown for its fleshy, elongated stem in preference to its leaves. The stem is peeled and may be eaten raw like celery, or it may be cooked.

REQUIREMENTS AND CULTURE

Lettuce germinates and grows at low temperature, and is one of the first vegetables to be planted in the spring. It tolerates a moderate freeze and does best in cool seasons, so lettuce should be planted as an early spring or a fall crop.

Hot weather causes lettuce sap to become milky and bitter. It also causes seed stalks to form, and stops continued leaf growth. Butterhead and crisp-head varieties are particularly sensitive in this regard.

Bolting and bitter flavor that result from high temperatures can be delayed by shading the crop. Row covers, cheesecloth or other shading material can be effective. Selecting a planting site that will be shaded in the afternoon is another alternative.

If transplants are used for early season production, they should be started indoors or in cold frames about March 10, March 15 or March 20 and then set in the garden about April 15 (east), April 20 (central), and April 25 (west).

A series of plantings 10 to 15 days apart will supply fresh lettuce for an extended period. Lettuce seed should be sown thinly in rows about 1 1/2 to 2 feet apart and covered with 1/2 inch of fine soil.

Leaf lettuce should be thinned to a stand of 3 inches between plants. Allow 6 to 8 inches between Butterhead varieties and 10 to 12 inches between crisp-head varieties. One packet of seed will sow 50 feet; one ounce, 100 feet of row.

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An alternative way to grow leafy types of lettuce is in a wide row. Seed can be broadcast thinly and lightly covered with soil in an area 1 to 2 ft. wide and as long as is practical. Following germination, as the seedlings enlarge, plants can be thinned to 1 1/2" x 1 1/2", then 3" x 3", then 6" x 6" spacing or even greater. The plants removed can be transplanted or used on the table.

For home owners with limited space, lettuce can serve double duty as a border plant in ornamental gardens. The various leaf colors available can be used to develop unique patterns in the border. Lettuce is a useful crop in settings where shaded sites must be used for gardens because it will grow quite well under low light conditions. Lettuce also adapts well to hydroponic or "pillow" culture in greenhouse or window box production. "Container" gardening with lettuce in almost any type of container can be successful.

Gardeners should include lettuce in their selection of vegetables for fall planting. Growing conditions that combine good light and cool temperatures are conducive to the development of high quality lettuce.

PEST PROBLEMS

Several species of aphids and the cabbage looper are insect pests that frequently attack lettuce. Besides feeding damage that reduces quality, insects can spread diseases. Therefore, control of the insects and nearby weeds is important.

The fungal diseases downy mildew, white mold (Sclerotinia), grey mold (Botrytis), and powdery mildew; viral diseases lettuce mosaic and western beet yellows; and the mycoplasm-induced aster yellows are diseases that can be damaging to lettuce. Use of clean seed, sanitation - especially control of weeds in and near the lettuce planting - and control of insects are the most effective ways to combat those diseases. Good air movement through the canopy of lettuce does much to minimize problems with fungal diseases.

HARVESTING

Crisp head lettuce is ready for harvest when the heads are solid and the tops become yellowish green. Butterhead varieties may be harvested when a loose head is formed.

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Heads should be cut at or slightly below the soil surface. Be careful to avoid damaging the outer wrapper leaves. Trim damaged or soiled leaves at the base of the head before rinsing the heads in cool water when preparing for eating.

Leaf lettuce may be harvested any time after the plants are large enough to use. It is a good practice to thin leaf lettuce several times, removing the largest plants for use and leaving the smaller ones to develop. This extends the harvest of one planting for a considerable period of time.

R.E. Neild, Extension horticultureiculturist Emeritus
Roger D. Uhlinger, Professor

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CHAPTER 8

SPECIALTY POTATOES

IN THIS CHAPTER, YOU WILL LEARN:

- A little bit of potato history
- What's needed to grow great potatoes
- Looking at good-quality "seed"
- About pest control
- How to harvest and store potatoes
- The various aspects of marketing potatoes
- About cooking quality and nutrition
- Where to get more information about potatoes

Specialty Potatoes

USDA Department of Agriculture
Cooperative State Research Service
Office for Small-Scale Agriculture

The potato, one of the most important food crops, came under cultivation by South American "Indians" more than 2.000 years ago. Potatoes, of which there are hundreds of varieties in every shape, size, and color, were carried to Europe around 1500. From Europe they were introduced into the British Colonies in North America.
In 1992, the potato is one of several food crops featured in the Smithsonian Institution's National Museum of Natural History's exhibition "Seeds of Change," commemorating the 500th anniversary of Columbus' first voyage. For many years, the potato had its own Potato Museum, in Washington, D.C. (Also see *The Incredible Potato, National Geographic Magazine*, May 1982.)

Interest is increasing in the yellow-fleshed and other uncommon varieties-specialty potatoes. Yellow-fleshed potatoes are the rule rather than the exception in most countries. Some specialty potatoes available in the United States for many years were long considered of little commercial value. Now, however, with increased consumer demand, domestic potato breeders have begun to release some excellent yellow-fleshed varieties.

In Washington State, nearly 200 specially potato varieties and clones have been tested; some varieties appear with pink or purple flesh and skin colors ranging from buff to red. Many have given yields greater than 'Russet Burbank.' Erik J. Sorensen, Washington State University Cooperative Extension, Franklin County Courthouse, Pasco WA 99301, has results from test trials.

With per capita fresh potato consumption static or declining, the variety offered by specialty potatoes can add to sales. Despite hurdles, they have a bright future but will never completely replace the traditional white-fleshed, russet type.

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CLIMATE, SOILS, AND WATER

Although classified as a cool-season crop, commercial acreage can be found in alt 50 States, with Idaho, Washington, Oregon, Maine. Wisconsin, California, and North Dakota leading. Soil temperatures should be between 45 and 70 degrees F at planting time. Planting into cold soils delays emergence and increases the risk of seed piece decay.

Although rainfall often suffices, irrigation may produce highest yields. Potatoes need 18 to 30 inches of water to mature. Potatoes are shallow rooted, with most roots being in the upper foot of soil. Potatoes are sensitive to water stress. Well-drained, light textured soils, such as sandy loams or loamy sands, generally produce the highest quality potatoes.

GOOD-QUALITY SEED

Potatoes are vulnerable to several diseases, including blackleg, bacterial ring rot, and viruses, which can be transmitted in infected seed. To avoid such problems, certified potato seed is recommended. Not guaranteed to be disease free, potatoes certified by State agencies have shown no more than an allowable tolerance level for disease symptoms. For certain diseases, such as ring rot, the tolerance level is zero. To be certified, seed lots must be inspected in the field during the growing season AND in storage or at shipment.

A number of mail order companies also offer limited quantities of specialty potato seed. Among these are some run by innovative potato growers:

- Will Bonsall, Scatterseed Project, Box 1167. Farmington, ME 04938:
- David Ronninger, Ronninger's Seed Potatoes, Star Route 1, Moyie Springs, ID 83845

Both curators for Seed Savers Exchange.

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PLANTING AND CULTIVATION

In much of this country, potato seed pieces are planted 3 to 4 inches deep. But where soil moisture may be limited, seed pieces are planted an inch deeper. The amount of seed required varies according to seed piece size and plant spacing. A spacing of 9 to 12 inches between plants is common. Wider spacings often result in oversized tubers.

Cut seed is widely used, but whole seed is less sensitive to tuber decay. Cut seed pieces should be 2 to 2 1/2 ounces in weight, firm, and with at least one eye.

After planting, potatoes may be cultivated to help control weeds and to reshape beds. It is common to hill potato plants when they are 8 to 12 inches tall: Soil is mounded to a height of 2 to 3 inches around the plant base Some varieties, such as 'Yukon Gold,' set tubers high in the bed. Hilling helps maintain suitable soil cover to prevent greening or sunburning of tubers.

PEST CONTROL

The potato is vulnerable to pests. In addition to using certified seed, growers need many strategies to minimize insect and disease problems. Strategies include proper soil fertility and water management, crop rotation, sanitation, and the use of resistant varieties.

HARVESTING AND STORAGE

Time of harvest varies according to variety and intended market. Potatoes may be harvested with vines still green and tubers comparatively immature. Such potatoes are generally intended for immediate use as "new potatoes." Most potatoes, however, are harvested at full maturity. Indicators of maturity are tuber size, skin set, and death of the vine. Mature tubers store better than immature tubers and resist bruising better.

Many varieties of specialty potatoes, such as 'Michigold,' 'Donna,' and 'Yukon Gold,' produce a high percentage of A-size tubers- generally the most desirable size.

'Yellow Finn,' however, is an exception. The market prefers smaller sized tubers of this particular variety. With red-skinned varieties, the small C size demands the highest price. Many restaurants also prefer small potatoes.

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Potatoes store best at 40 to 50 degrees F, with adequate ventilation and relative humidity at 90 percent. It is important to exclude light to prevent greening. Only sound potatoes should be put into storage.
Varieties

The dark-yellow flesh of 'Yellow Finn' has become something of a standard. By comparison. 'Yukon Gold' flesh is relatively light-yellow. Many European varieties also have light-yellow flesh.

'All Blue' is oblong with purple skin and purple flesh. Sometimes called 'Purple Marker,' its striking appearance led to its use as a marker for the ends of potato plots. It can be baked or boiled and retains the purple flesh color even after cooking. 'Purple Viking' has purple skin with red stripes.

VARIETIES WITH COMMERCIAL POTENTIAL:

Yellow-fleshed with buff or yellow skin: 'Delta Gold,' 'Donna,' 'Michigoid,' and 'Saginaw Gold.' Yellow-fleshed with red or pink skin:
'Desiree,' 'Iditaried,' 'Red Gold,' and 'Rose Gold.' Yellow-fleshed with purple skin:

'Brigus.' And small sized or fingering potatoes: 'Banana' and 'Ruby Crescent.'

Good descriptions of potato varieties are in two out-of-print books often found in university libraries: "Description of and Key to American Potato Varieties," C.F. Clark and P.M. Lombard, USDA Circular No.741, Issued April 1946 (Revised November 1951) and "North American Potato Varieties," H.M. Darling. 1959 Potato Handbook, Potato Varieties Issue, Potato Association of America (PAA).

MARKETING

Marketing presents a challenge but the potato is a familiar crop and most consumers are willing to try colorful varieties. To successfully market specialty potatoes, farmers need to work with those who sell and promote vegetables.

Specialty potatoes have received national attention through articles in produce trade journals and the popular press. Supermarket chains have featured yellow- fleshed potatoes. At Larry's Supermarket in Seattle, a 4th of July promotion featured red, white, and blue potatoes. Without such efforts it is difficult to move specialty items beyond local markets and into the produce mainstream.

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Quality is of paramount importance to market acceptance. For the fresh market, appearance strongly influences sales. Color. size, shape, and defects shape consumers' first impression of quality. Texture, flavor, and nutritive value are less obvious, but still important quality components, affecting first sales little but greatly influencing subsequent sales.

Many restaurants feature specialty potatoes. Often customers who first tried them in a restaurant purchased them later in supermarkets. Some brokers and others who pack and ship fresh produce concentrate on specialty potatoes.

Marketing specialty potatoes is complicated by the fact that most potatoes are not sold by variety name. Some specialty potatoes have characteristics that lend themselves to product differentiation. 'Yellow Finn' has a characteristic flattened shape and deep eyes.' 'Yukon Gold' is distinguished by the pink coloration around its eyes. Packaging can also be important to market success. Bags that display the variety name along with cooking or nutritional information are useful.

Yellow-fleshed varieties have already been bred that can be used for either fresh market or processing. 'Saginaw Gold' produces a chip with good color and taste. Purple or pink potato chips and yellow french fries are among possibilities for processed specialty potatoes. Looking beyond local markets, specialty potatoes and potato products may also have potential for export.

The market for specialty potatoes is limited and overproduction is a real danger. Growers are advised to develop a market before trying new crops-and then only on a limited acreage.

COOKING QUALITY AND NUTRITION

Fresh potatoes contain about 80 percent water. Solids, or dry matter, is highly correlated with texture. A mealy texture is associated with high solids, a waxy texture with low solids. Although individual tastes vary. varieties such as 'Michigold' have a mealy texture usually considered best for baking or french-frying. Varieties such as 'Red Gold.' with a waxy texture, are more often used for boiling or in salads.

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Potatoes are an excellent source of carbohydrates and contain valuable amounts of protein, minerals, and vitamins. Nutrient levels vary not only by variety but also according to the maturity of the crop and storage time. Nutritive content can be used to market specialty potatoes. It appears that the darker the yellow flesh color, the higher the level of vitamin A.

FOR MORE INFORMATION

In addition to the U.S. Department of Agriculture, State universities and county Cooperative Extension personnel can provide useful information on local production methods and marketing practices. PAA (Dr. David Curwen, Secretary, University of Wisconsin, Hancock Ag Research Station, Hancock WI 54943) publishes a Potato Extension Specialists Directory that lists University faculty members in 46 States and the District of Columbia. PAA also has an annual meeting and publishes "The American Potato Journal," a monthly. (Contact Linda Best, Membership Secretary, PAA, 8 Holmes Hall, University of Maine. Orono ME 04469-0163.)

Many potato production educational programs are sponsored by the Cooperative Extension System. In Washington, the Washington State Potato Conference and Trade Fair is held each year. Similar programs exist in Idaho, Maine, Michigan, Nebraska, and Oregon. Potatoes are included in numerous other conferences.
Other Information Sources

There are many excellent publications:

Delta Golds... Consumer Response to Yellow Fleshed Potatoes, Applied Market Research Report #2." Agriculture and Resource Economics, 206 Winslow Hall, Univerisity of Maine, Orono, ME 04469.

"Potato Handbook." Agricultural Communications Center. 111 Ag Sciences Building, University of Idaho. Moscow, ID 83843.

*"Potato Growers Handbook."*Washington State Potato Commission. 108 East Interlake Road, Moses Lake, WA 98823.

"Potato Varieties - An introduction to variety characteristics, management and performance in the Klamath Basin." University of California Tulelake Field Station. P.O. Box 447. Tulelake. CA 96134.

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*"North American Potato Varieties."*Potato Association of America. 8 Holmes Hall. University of Maine. Orono, ME 04469-0132.

"Selecting Potato Varieties for Michigan." Michigan State University. Bulletin Office. P.O. Box 231, East Lansing, Ml 48823-0231.

"Integrated Pest Management for Potatoes in the Western United States." Publication 3316. Agricultural Sciences Publications. Division of Agricultural Sciences, University of California, Berkeley. CA 94720.

*"Compendium of Potato Diseases,"*American Phytopathological Society. 3340 Pilot Knob Road. St. Paul, MN 55121.

"A Guide to Monitoring Potato Pests in New York State, 102 IPM 107." Cornell Cooperative Extension, Research Center, 7 Business and Technology Park, Ithaca, NY 14850.

"Potato Diseases, Agriculture Handbook No.474," Superintendent of Documents, U.S. Government Printing Office. Washington, DC 20402.

A computer software program, *Potato Crop Management,* is available from the University of Wisconsin, WISPLAN Computing, 302 Hiram Smith Hall, 1545 Observatory Drive, Madison, WI 53706.

Prepared by Erik J. Sorensen of the Washington State University Cooperative Extension and George B. Holcomb of the Office of Public Affairs, U.S. Department of Agriculture, for USDA's Office for Small-Scale Agriculture (OSSA); Howard W. "Bud" Kerr, Jr., Program Director. OSSA's address:

Cooperative State Research Service, USDA,
Room 342-D, Aerospace Building.
Washington. DC 20250-2200.
Telephone: 202-401-4640
Fax: 202-401-5179

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CHAPTER 9

SPINACH AND SWISS CHARD

IN THIS CHAPTER, YOU WILL LEARN:

- About the cultural requirement of spinach and swiss chard
- About the different varieties
- The details of harvesting and storage of your crop

Spinach and Swiss Chard

Spinach

Spinach is a cool season crop and belongs to the goosefoot family (Chenopodiaceae), along with Swiss chard and beets. Spinach is low in calories. It is a good source of vitamin C, vitamin A, and minerals, especially iron. After washing the leaves, cook them in a covered pan using only the water clinging to the leaves. After cooking, add salt and butter, vinegar, or mustard for added flavor. Spinach may be prepared in a souffle, creamed soup, or used raw in salads.

CULTURAL REQUIREMENTS

Spinach is very hardy and can withstand temperatures as low as 20 F. It can be the first garden vegetable planted in the spring since the seed germinates at low temperatures. Spinach thrives in cool, moist conditions. It does not tolerate hot weather and begins to bolt or go to seed as daylight lengthens and temperature increases in June. Two spinach crops are possible in most regions; the second can be planted in late summer for harvest in the fall.

Fresh spinach seed germinates readily at 38-40F and may be planted with good results when soil temperatures are 50 to 60 F. Higher temperatures reduce seed germination. Soil temperatures above 85 F will inhibit seed germination. Spinach seed rapidly loses viability. Fresh seed should be purchased each year. Spinach should be planted in rows 1 to 2 feet apart. The seed should be placed 1/2 inch deep and planted to have one plant every 3 to 4 inches after thinning. One packet of seed will plant 25 feet of row. One ounce of seed will plant 100 feet of row. Commercial seeding rates are 12-15 pounds per acre.

Spinach requires a soil pH of 6.0 - 6.5 and will not grow well if pH is below 6.0. Indications of possible soil pH problems include poor seed germination, yellowing and browning of the margins and tips of seedling leaves, browning of roots, and generally slow growth or death of the plants. If soil pH is too high, leaves may show a generalized yellowing or chlorosis.

Spinach is adapted to a range of soil types, from light and sandy to silty clay loams. In heavier soils, spinach should be grown on raised beds to improve drainage for the shallow-rooted plants. Seedling damping off can be reduced by use of raised beds. After seeding, the soil should be kept uniformly moist. When irrigating the garden, apply

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water in the morning so that the foliage is dry before dark. Apply sufficient water to moisten the soil to a depth of six inches. A uniform supply of soil moisture is required to produce high quality, tender spinach.

Spinach growth starts slowly and then accelerates during the final 21 days before harvest. If a soil test has not been taken, broadcast 5-10-10 fertilizer at 30 pounds per 1,000 square feet before planting. Spinach should be side-dressed once during the growing season with ammonium nitrate at 1 pound per 100 feet of row or calcium nitrate at 2 pounds per 100 feet of row. A total of approximately 150 lb/A of actual N is recommended, usually applied 1/2 preplant and 1/2 as a broadcast application 3-4 weeks after seeding. Spinach requires fairly high boron (B). Most soils supply adequate boron for spinach. Spinach plants can become stunted with dark roots and small, flattened, yellow leaves when boron is deficient. An application of 1 pound of boron (10 lb/A of borax) broadcast before seeding should eliminate the problem in subsequent years. NEVER use boron unless needed and then only in the recommended amounts. Boron is highly toxic to many other garden plants including snap beans, cucumbers, peas and strawberries.

Emergence rate varies depending upon soil temperature; time from planting to harvest also is highly temperature dependent. Generally, most varieties can be harvested 45 to 50 days after planting. Spinach can be harvested from the time the plants have five to six leaves until just before seedstalk formation.

VARIETIES

Spinach varieties are separated into types with flat leaves, leaves that are semi-savoyed (crinkled), or those that are heavily savoyed. The flat-leafed types are used primarily by the processing industry since soil particles are easier to wash off. The thick leaves and ease of washing also make this type attractive to certain fresh market consumers. Whatever type, fresh spinach should be crisp, succulent and dark green, with a minimum of stems.

During the past ten years, a major change has occurred in the type of spinach grown, primarily due to advances in breeding mildew resistance into types adapted to North America. The hybrid varieties show superior vigor, uniformity, bolting resistance and disease resistance compared to the older varieties. The more upright growth habit makes harvesting easier and keeps the leaves cleaner.

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Seven R is a standard, semi-savoyed cultivar that is best for early spring and fall plantings. Plants are large and quick-growing. The erect leaves are good for mechanical harvesting. It is resistant to both race 1 and race 2 of downy mildew.

Marathon has a savoy leaf. It is better than Seven R for spring plantings since it is slower to bolt (form flower stalks) in warm weather. The leaves are large, dark green, semi-erect and long standing. It is used for both fresh market and processing from late winter and spring plantings.

Melody F_1 is a semi-savoyed type. Plants are large and quick growing with very deep color. Leaves are thick and rounded. It is resistant to downy mildew and cucumber mosaic virus.

Vienna F_1 has large, savoyed leaves forming an erect plant type. It is best planted in the fall as it tends to bolt in spring plantings.

Grandstand has semi-savoy leaves, is long-standing and semi-erect. The leaves are medium large and medium green. It is resistant to downy mildew and mosaic and is used in the spring, primarily for processing.

Tyee F_1 is becoming a new standard for savoyed spinach. The leaves are dark green with an upright growth habit that produces cleaner leaves. It is a bit slower growing than some other savoy types but stands well in hot weather because it is slow to bolt. It is good for a spring crop. It also is tolerant to downy mildew races 1 and 3.

Long Standing Bloomsdale is a heavy-savoy type, adapted for late spring and early summer harvest. Leaves are dark green and medium large. Plants are medium large and erect. It is an older variety. Other Bloomsdale types, such as Long Standing Savoy #653, have been selected for earlier maturity and slow bolting.

If growing spinach for shipping, the savoy varieties are best because they pack less closely than the smoother types and retain market quality better. They are slower to wilt or turn yellow after harvest. Smooth-leafed varieties are easier to clean and prepare for canning or freezing. Contact the local Cooperative Extension office for additional information if you are considering growing spinach for wholesale shipping.

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PESTS

Diseases on spinach tend to be those that develop under cool, moist conditions. One symptom characteristic of downy mildew is light-yellow areas on the leaves. Infected young plants may be pale green, stunted, with leaves heavily savoyed. During periods of high relative humidity or rainfall, sporulation will occur, appearing as a white mass, eventually turning purple. Most modern varieties are resistant to downy mildew. White rust is a serious problem in spinach production in the southern Great Plains and Texas. White, blister-like pustules appear, usually only on the lower side of the leaf. Surrounding tissue browns and dies. A few fungicides are available for use in spinach produced on a commercial scale. There are no fungicides registered for use by home gardeners on spinach.

Insect pests include the green peach aphid, seed corn maggot, cabbage looper, cucumber beetles and the spinach leaf miner. Aphids can be a major problem because they transmit virus to the spinach and are difficult to control, especially in the savoyed leaves.

Spinach is shallow rooted. Cultivation to remove weeds must be shallow to minimize damage to the roots. A few herbicides are available for commercial production. For smaller plantings, hand weeding is recommended.

Contact your county Cooperative Extension office for methods to control insects, weeds and diseases in larger plantings.

HARVESTING AND STORAGE

Spinach can be harvested until seedstalk formation. Spinach planted for early harvest is subject to bolting as daylight lengthens in late spring and early summer.

Spinach is harvested by cutting the stem below the head or rosette of leaves. The crinkled leaves should be rinsed thoroughly in cold water to remove any grit soil particles. The leaves are then bunched. Remember that fall spinach is very hardy and not easily damaged by frosts. Harvest dark green, tender leaves that are 3 to 6 inches long. In the home garden, start by picking the outer leaves and then harvest the newer leaves as they reach the desired size. Spinach not needed immediately for eating is best left in the field until severe freezing is forecast. Harvested spinach can be kept in a moisture-retentive container in the refrigerator for as long as 40 to 50 days.

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Swiss Chard

Swiss chard is a type of beet that is grown for its large leaf stalks and leaves. It produces no enlarged fleshy roots. It is low in calories and minerals and a good source of vitamins A and C. Chard leaves are best prepared like spinach or beet greens - cooking with only the water that clings to them following washing. A bit of garlic or nutmeg and butter enhances the flavor of chard leaves. Chard stems have a delicate flavor much like asparagus and are prepared in a similar way. Stems should be stripped of leaves, cut into conveniently sized pieces, and gently steamed in salted water until tender. Cooked and chilled stems are very good with salad dressing or mayonnaise. Leaves and stems may also be cooked together.

The garden fresh quality of Swiss chard is well preserved when frozen. Chard withstands hot weather and provides greens and stems when spring spinach and asparagus are no longer available. With proper care, it will continue to produce through much of the fall. It is not uncommon for Swiss chard to remain fresh in the garden through the first snowfall or until temperatures fall into the teens Fahrenheit.

CULTURAL REQUIREMENTS

Chard, like the larger rooted table beet, is a hardy vegetable. It grows successfully regardless of soil type, length of day or temperature.

Seeds are scattered in the row 1/2 to 1 inch deep. In home gardens or market gardens, chard seedlings should be thinned to a 3-inch spacing between plants. Thinnings can be eaten cooked, or raw in salads. Rows should be spaced 2 to 3 feet apart. One standard packet of seed will plant 25 feet of row; one ounce will plant 100 feet. The closer spacing allows the foliage to shade the soil better and helps prevent germination of warm season grassy weeds.

VARIETIES

Chard varieties are ready for harvest about 55 days from planting. There are not many different varieties of Swiss chard.

Lucullus is an older variety. It produces large, crumpled, dark-green leaves with thick, succulent pale green stems.

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Fordhook Giant produces leaves that are heavily crinkled and dark green, 24-28 inches tall. The midrib is broad, thick and white.

Rhubarb, a strikingly different variety, has use as an ornamental as well as for eating. Rhubarb has dark green crumpled leaves with wine red veins borne on bright crimson leafstalks, 20-24 inches tall.

PEST CONTROL

Pests affecting Swiss chard are similar to those in spinach. Control measures for home gardeners and commercial plantings are limited.

HARVESTING

Harvesting is done by removing the outer leaves, allowing the center leaves to grow. Stems of these outer leaves should be cut, while still tender, 1-2 inches above the soil surface. Leaves are of best quality just when fully expanded or slightly smaller. Take care to avoid damage to the growing bud in the center of the growing leaves. When harvested carefully, chard will continue to produce leaves through the summer into late fall. Swiss chard is prepared for market by washing thoroughly, discarding any yellowed or damaged leaves, and bunching the leaves. Storage is not recommended, although quality can be maintained for a shorticulture time by icing and refrigeration.

Laurie Hodges, Extension Vegetable Specialist

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CHAPTER 10

SPECIALTY VEGETABLES

IN THIS CHAPTER, YOU WILL LEARN:

- About special considerations for the small-scale entrepreneur
- About the demand for miniature vegetables
- The identity of some possible market outlets
- How to price your specialty vegetables
- About various ideas for production

Specialty Vegetables
A Small-Scale Agricuture Alternative

United States Department of Agriculture
Cooperative State Research Service
Office for Small-Scale Agriculture

There is a growing demand for Latin and other 'ethnic' vegetables in most of the larger cities such as Chicago, Miami, and New York. To supply customers' needs for such specialty items, many major chains stores across the country are turning to specialist marketers, many of whose supplies are small-scale growers.

Specialty vegetables being introduced or reintroduced by immigrants from the Pacific Basin, Africa, Latin America, the Caribbean, and even Europe include amaranth, arrowroot (Chinese potato), cipolines, daikon, donqua, elephant garlic, fava bean, fiddlehead green, gil choy, Japanese eggplant, jicama, manzano banana, moqua, napa, taro root, tomatillo, and yuca (also known as sweet cassava). Even the native watercress is enjoying newfound popularity. Many such vegetables are described in a book, *Windows of Opportunity: The Market for Specialties and Organics*, ($25), by Nancy Lee Bentley, marketing consultant at The Food Circle, P. O. Box 62, Cabery, IL 60919. (One fresh produce item likely to capture consumers' fancy is the miniature watermelon, to be discussed in more detail in a fact sheet on fruits.)

THINGS TO CONSIDER

Above all, a small-scale entrepreneur interested in growing specialty vegetables must be cautious, advises Frieda Capian. She is an ace California-based national-chain marketer of specialty produce for nearly 30 years. Her successes include Jerusalem artichokes (marketed under the name she coined, "sunchokes") and many other specialty vegetables. She gets as many as 50 phone calls a week from potential vegetable or fruit growers asking how to get started.

Frieda, as she is known in the trade, tells callers first to check with an expert, such as a Cooperative Extension Agent or Soil Conservation Service soil specialist with the U.S. Department of Agriculture (USDA), to learn what vegetables their soil can grow best. Next,

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from seed company, "find out what's new and available." Then she suggests they contact her to learn whether she can market what they plan to grow. (Her address: Frieda's Finest Produce Specialties, Inc., P.O. Box 58488, Los Angeles, CA 90058).

Chances are, if an item is really new, she will advise them to grow only a few rows, just to try it out. She cautions growers about making certain before contracting that they have packing and shipping arrangements worked out. "It's up to the grower to arrange transportation," she pointed out.

Vegetables have to be packed according to standards; and growers must have arrangements to precool the vegetables for shipment. Failure to have all the links in the chain from soil to market can doom an enterprise.

To help growers, shippers, carriers, and receivers learn the standards and to reduce postharvest losses and expand the markets for highly perishable, high-value vegetables (and fruits), the Export Services Branch of USDA's Office of Transportation (410 McGregor Building, Washington, DC 20250-4500) has a *Tropical Products Transport Handbook* available in 1988. It discusses maintaining quality of fruits, vegetables, plants, and flowers during transportation.

The booklet emphasizes proper planning, grading, packaging, and precooling practices as particularly important for crops shipped long distances from areas with tropical and subtropical climates. The information is presented in a brief manner with many illustrations. The handbook also discusses the choice of mode of transportation, checking the transportation equipment before loading, loading practices and recommended intransit and storage procedures. A summary of recommendations is given for 120 fruits and vegetables, most being tropical in origin. (Telephone 202-653-6317.)

One key need both before and just after harvesting is adequate labor to gather and pack crops quickly for market when they are ready. Most specialty crops can't be harvested by machine. A U-pick operation would solve the labor problem; but not all areas support pick-our-own operations. Each producer must evaluate his or her prospects for U-pick carefully.

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Lawrence Rinkenberger, Indiana farmer who spoke at the 1986 "ADAPT 100" conference (sponsored by Meredith Corporation's *Successful Farming* magazine), said his pick-your-own acreage has been declining since 1981, despite his fast checkout lanes and a recreational atmosphere. Fewer customers are finding time for picking, and supermarket have become more competitive with higher quality and lower prices.

The text of Rinkenberger's talk (along with discussions of many other alternative farming ideas) is in the book, *ADAPT/100*, available for $12.95 from *Successful Farming* at P.O. Box 10652, Des Moines, IA 50336.

MINIATURES IN DEMAND

In deciding what to produce, entrepreneurs may pinpoint demand. In some markets and gourmet restaurants, demand is often high for miniature or "baby" sizes of conventional vegetables, such as squashes.

Some varieties of vegetables have been especially developed to grow small, or miniature size. Others are simply picked at an immature stage; it is important to know which ones. Many minivegetables are being grown in California, Florida, Texas, and Mexico year round. With good soils, they can be grown in many States in summer, or they can be grown in greenhouses. Growing and marketing minivegetables is tricky. Besides being produced from appropriate varieties, they must be harvested precisely when they are at a sweet rather than bitter stage. Not all immature vegetables qualify.

SOME MARKET OUTLETS

Any vegetables can be labeled "gourmet" if marketed at peak condition, according to David Miskell, a speaker at the 1986 "ADAPT 100" conference.

For information, Miskell noted seed companies and market outlets such as Frieda Capian's; "Fresh and Healthy" of Lehigh Valley organic Growers, Inc. (125 West Seventh Street, Wind Gap, PA 18091); Green Leaf Produce (1980 Jerroid Avenue, San Francisco, CA 94124); and Flying foods International (43-43 Ninth Street, Long Island City, NY 11101). Both Sibella Kraus, Green Leaf planner, and Walter Martin, founder and Managing director of Flying Foods, say their companies are always interested in hearing from growers with plans for novel produce(such as colorful lettuces.

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Miskell mentioned some of the gourmet lettuce being marketed, including Merveille de Quatre Saisons, Rouge d'Hiver, Red Sails, Red Romaine, Red Salad Bowl, Oak Leaf, and Boston type. Miskell may be contacted at Shelbourne, VT 05482, where he produces organic vegetables on 3 acres with four greenhouses.

The produce market (gourmet or otherwise) is extremely competitive. The specialists emphasize that when too many people begin growing a vegetable crop, it is no longer a specialty that commands a premium price. Above all, the experts emphasize that people should NOT plant first and try to sell later.

One way to beat the competition as well as take advantage of the U-pick solution to labor shortages, is described in Dr. Booker T. Whatley's book, *How To Make $100,000 Farming Acres,* ($17.95, softcover; $24.95, hardcover, from Rodale Institute, 222 Main St., Emmaus, PA 18049). He explains how clever growers can build a 'guaranteed' or contract market by organizing a clientele membership club. Members buy rights to pick vegetables and/or fruits at rates adjusted regularly to be below supermarket prices. This kind of club, of course, takes as much servicing as any organization.

PRICE INFORMATION

To help make decisions, operators can seek price data from many sources. One is USDA's Agricultural Marketing Service (AMS). Its Fruit and Vegetable Division has a Market News Branch (headed by W.H. Crocker , Room 2503-S, AMS, USDA, Washington, D.C. 20250). AMS reports daily on prices and shipment sizes at 20 of the Nation's biggest metropolitan centers. AMS will send inquiries data on subscription fees for reports from various cities.

While all major markets detail wholesale prices on the most common produce, not all report gourmet vegetables prices. However, AMS reports from New York and San Francisco often have lists of vegetables or herb designated "oriental" or "miscellaneous." Some sell by the pound, others by the dozen (bunches) or by the carton or lug.

Caplan says the farmers price can be estimated by deducting 30 percent from the price that AMS shows for any particular item.
For data on local prices and competition, the best source of data is the produce manager of the nearest large gourmet grocery store. If there is no gourmet store, the owner of a gourmet restaurant might discuss prices and supplies.

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PRODUCTION IDEAS

Many sources of vegetables production information include county offices of the Cooperative Extension Service (CES), supported States, State universities, and USDA. Most counties have CES offices.

The Produce Marketing Association (PMA, 1500 Casho Mill Road, Newark, DE 19714-6036) can provide a list of articles on specialty vegetables to nonmembers of PMA for $20 (the search cost) plus $10 for a set of computer page printouts of up to 10 pages plus $1 per additional page.

A recent PMA bibliographic printout on "exotic produce" (which includes fruits as well as vegetables) covered about 18 pages. Two other pages were on Hispanic produce operations and Oriental produce and marketing.

Typical articles are two in *Restaurant Business*, "Oriental market poised for explosive chain growth" and "Oriental: Fast food of the next generation ," and one in *Supermarket Business,* "Oriental items can be bonanza for produce section." Items on the Hispanic list include: "Tips on capturing a piece of Hispanic grocery market," in Packer newspaper; "The emerging Hispanic market," in *Produce and Floral Retailing* magazine; and "Ethics perishables bring Denver Hispanics to TJs," in the *Supermarket News* newspaper.

USDA, Purdue University, and the CES (at West Lafayette, IN 47907) have a publication (HO-194) available at no charge: *Guide to Production Information for Commercial Vegetable Grower*. It is aimed mainly at readers in Indiana and the Midwest, and it lists publications of wider use, such as *The Basics of Trickle Irrigation*, from the University of Illinois.

Purdue also has published the 70-page *Indiana Vegetable Production Guide for Commercial Growers*. Numbered ID-56, it is available from the Publications Mailing Room, 301 South Second Street, Lafayette, IN 47905-1092, at $4. It summarizes recommended varieties of common vegetables, seeding rates, fertilizer rates, insect and disease control measures, and safe use of agricultural chemicals. The guide, updated every 2 years, has supplement alternate years.

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The Purdue list names several vegetables books issued by private publishers and the 1977 USDA publication, *Growing Your Own Vegetables*, Ag. Info. Bulletin No. 409. No longer available from the government, this 244-page "how to" book may be found in some libraries. Because of its age, readers will want to update its pesticide information through their Extension agents.

Purdue's list also notes many periodicals on vegetables. While many emphasize the chemical control of pests, some are oriented toward organic methods, using biological instead of chemical approaches to control pests.

Another useful USDA publication, *Growing Vegetables on the Home Garden,* 49 pages, is available from the Superintendent of Documents, Government Printing Office (GPO), for $2.25. Ask for HG 202, Stock No. SN 001-000-004454-1. USDA 's 1977

Agricultural Yearbook was the 392-page *Gardening for Food and Fun,* available from GPO for $12. Its Stock No. is SN 001-000-036789-3.

USDA's National Agricultural Library (NAL, Room 111, Beltsville, MD 20705) also has a bibliography listing publications on vegetable gardening and another on marketing of horticultural crops.

This report is adapted from a factsheet prepared by George B. Holcomb of the Office of Information, U.S. Department of Agriculture, for USDA's Small-Scale Agriculture (OSSA); Howard W. "Bud" Kerr, Jr., Program Director, Office of Samll Scale Agriculture.

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CHAPTER 11

BLUEBERRIES

IN THIS CHAPTER, YOU WILL LEARN:

- About the commercial attributes of growing blueberries
- The site and pre-planting considerations
- How to select plants
- About various aspects of field layout and planting
- The cultural techniques for a successful blueberry crop
- How to market your crop

Blueberries

United States Department of Agriculture
Cooperative State Research Service
Office for Small-Scale Agriculture

The blueberry is delicious as a fresh fruit snack or in a variety of foods such as blueberry pies or muffins. Although most large-scale commercial blueberry operations are in either Michigan or New Jersey, highbush blueberries can be cultivated throughout much of the United States-with careful site selection and proper cultural practices.

Highbush blueberries fit nicely into small-scale farming. In the Midwest, by selecting early or late varieties, harvesting can begin in early June and last into August. Local marketing by pick-your-own (PYO) customers, at farmer's markets, or ready-picked sales to nearby stores is particularly feasible for small-scale operators in close proximity to metropolitan areas. Blueberry sales can supplement income from primary sources.

Growing highbush blueberries is labor and management intensive. Most work can be performed by hand, but specialized equipment may be beneficial. Blueberry production requires a substantial investment In time and money. Plantings require 2 to 3 years to establish and are not harvested until the third or fourth growing season. Many things can go wrong during the first years and a knowledge of blueberry biology and pest management is essential. Without good cultural practices-including insect, weed, and disease control-plantings may be doomed even before first harvest. Ideas on pest control practices should be available through the local Cooperative Extension Service (CES).

Per-acre returns can be high. A mature planting can gross $5,000 per acre and return $3,000 or more with correct marketing, management, and growing.

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SITE AND PRE-PLANTING CONSIDERATIONS

Blueberries should ideally be planted on a gently rolling slope to provide good air and water drainage. Good air drainage reduces likelihood of blossom damage from late spring frosts. blueberry roots are very sensitive to standing water so they need good surface and internal water drainage. Although a sandy soil is best for drainage, heavier soils may be used if internal drainage is adequate. This may require either planting on ridges or placing tiles to improve drainage. In choosing a site, give consideration to a water source for irrigation. If the crop is to be harvested by PYO customers, the location should be easily accessible to parking nearby.

Blueberry plants are very sensitive to soil pH and require acidic soils for success. Optimum soil pH is 4.8 to 5.2, although levels as high as 5.5 are acceptable. The soil pH can gradually be reduced through use of acid-reaction fertilizers. Soils with pH levels of 5.5 to 6.0 can be used if the soil pH is lowered using an agricultural sulfur 1 year or more prior to planting. The sulfur required to lower soil pH varies with soil type. It may be economically unfeasible to adjust the pH of some soils. Therefore, prior to planting, another soil pH test should be conducted to learn whether the soil pH has attained a satisfactory acidic reaction.

Planning should begin at least 1 year prior to planting blueberries. This time schedule allows for adjusting soil pH (if needed), tiling, ditching, and digging a pond or drilling a well. During this time, it may be possible to control perennial weeds which may be difficult to stop with herbicides registered for use on blueberries after planting. A green manure crop of rye or wheat may be grown and then turned under to improve soil tilth. Any cultivated crop grown during this preparatory year may help reduce insect and weed problems. If herbicides are used to manage weeds during the preparation of the site for blueberry production, then be aware of the time limits for degradation of the herbicide residues in the soil.

PLANT SELECTION

Cultivars (cultivated varieties) are the keys to success and are selected a year ahead. They should be booked with a reputable nursery. The CES (Extension agent) should have information on which cultivars are best adapted for local use. A potential grower

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may also learn about cultivar selection by visiting other growers and from nursery professionals. Most nurseries offer rooted cuttings, 2-year-old bare-rooted fieldgrown plants, and 2-year-old containerized nursery stock.

Many small-scale operations buy containerized planting stock because of the increased survival and earlier production they may offer. If containerized stock is used, it is wise to pick up the plants at the nursery and eliminate shipping expenses.

FIELD LAYOUT

Blueberries benefit from cross pollination so growers should alternate cultivars with similar flowering seasons in alternating blocks of 2 to 4 rows. Rows ideally run north to south to allow for uniform sunlight. However, any orientation is acceptable. Blueberries are normally grown with wide row spacings, with the area between rows seeded down to a perennial cover crop such as Kentucky bluegrass or fescue.

Row spacings of 10 to 14 or more feet ensure that mowing and spraying can be done by tractor, although narrower spacings will allow for equipment use during the first few years of planting. However, without at least 10-foot spacing the plants will grow large enough that a tractor can no longer be driven between the rows. Spacing within the row is commonly 4' or 6'.

Planting for PYO operations should allow for customer convenience and handling. Rows should be interrupted with cross-walks or drive alleys about every 200'. It is also helpful to arrange cultivars with similar ripening seasons together so that harvest can progress in an orderly fashion.

PLANTING

Planting of containerized nursery stock may occur in either early fall or early spring. Bare root nursery stock is normally planted in the spring. Fall planting should occur between late September and early October. The roots of these fall-set plants will continue to grow until soil temperatures fall below 45 F. Spring plantings are often delayed because of wet weather. Fall-set plants are already in place and have the advantage of early spring growth, which is often missed in spring plantings due to wet weather delays. Fall-planted blueberries must be mulched prior to winter in areas in danger of frost heaving. Spring planting should begin as soon as the danger of severe frost has passed.

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Blueberries are shallow rooted so the planting hole needs to be wide. Holes may be dug by hand or with an oversized tractor-mounted posthole digger. Some growers prefer to plant in a plow furrow. After the hole is dug, the plants should be planted as deep as they were in the nursery. Usually about 1 pound of moist acidic sphagnum peat moss is used per plant during planting. It is mixed with soil during backfilling of the planting hole should be thoroughly wet prior to using. Failure to wet the sphagnum peat moss can result in it drawing moisture out of the soil and causing the newly set plants to dry out.

After planting, bare-root plants should have 1/3 to 2/3 of the branches removed. This allows the plant root system to be in balance with the shoot system and increases survival by reducing transpirational demand. Plan containerized stock reduces the need for pruning branches at planting time. Flower buds should be rubbed off to ensure that energy is channeled into vegetative growth.

MULCH AND IRRIGATION

In most regions where highbush blueberries can be grown, both mulch and irrigation are essential for successful production. Mulch goes on newly set plants soon after planting and irrigation should be ready before newly set plants dry out. Many materials are suitable for mulching blueberries, but sawdust Is most common. Mulch keeps soil temperatures cooler during summer, reduces weeds, and maintains soil moisture more uniformly.

Although mulch helps save moisture, it does not eliminate the need for irrigation. Blueberries are very sensitive to drought and irrigation is essential in most areas. Trickle irrigation offers the advantage of being more efficient, but it does not allow for the frost protection that overhead systems can provide. In areas where late spring frosts are of little concern, trickle irrigation is normally chosen because of its increased efficiency. Irrigation then occurs without interrupting spraying or harvesting.

CROP MANAGEMENT

Bird depredation can be the biggest problem of small-scale producers, sometimes causing crop losses of over 70 percent. Scare devices and exclusion by netting are commonly used to reduce losses.

Insect and disease problems may be small in areas of few blueberry plantings. The CES can provide information on weed, insect, and disease control.

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MARKETING THE CROP

The principal small-scale market may be consumers in local communities. A high percentage of blueberries are direct marketed locally. The potential trade area for blueberries tends to be larger than for strawberries. Blueberries also offer other advantages over strawberries for PYO operations. Blueberries require little stooping. Customers find them easy to freeze, requiring little preparation other than washing, and easy to use. PYO surveys have found a trend towards an increased average age of PYO consumers.

Sales of ready-picked blueberries at the farm or local markets bring higher prices to producers from consumers who desire farm fresh produce, but do not wish to PYO.

The blueberry crop is usually sold within 60 days, depending upon weather and varieties. Weekends are usually the busiest. Coordinating sales advertising and promotion with peak harvests challenges even experienced growers.

PYO growers must be market oriented, plan far ahead, seek alternative market possibilities, train employees, and develop successful advertising, especially a good farm logo. Before starting any small-scale enterprise, a farmer should study the potential markets, trade areas, competitors, and the advertising media. About 450 PYO customers can harvest 1 acre of blueberries (6,000 pounds). PYO blueberries are usually sold by weight in pounds and/ or ounces. The scales used for sales should be inspected by the Weights and Measures Division of the State Department of Agriculture or Commerce.

A direct market business requires time to develop. Blueberries lend themselves nicely to market development because they require 6 years or more to reach maximum yields. Careful attention to a business image, including the logo, quality of fruit, and how fields are maintained, is essential. A direct marketer should exceed customer expectations. Merely raising high-quality blueberries is not enough. Often customers enjoy the recreational aspect of a trip to a country farm as much as obtaining high-quality produce at reasonable prices. They want well marked roads; adequate parking; and friendly courteous service.

Since accidents do occur, growers must have adequate insurance. A regular farm insurance policy may not cover liability to PYO customers.

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FOR MORE INFORMATION

State university and county CES personnel can often provide information from local Ag Experiment Stations which is geared to local production and marketing. For example, the University of Illinois conducts an annual "Small Fruit School" and publishes a Proceedings, which includes information on blueberries as well as other small fruit. For information write to J.D. Kindhart, University of Illinois, Dixon Springs Agricultural Center, R-1, Box 256, Simpson, IL 62985. Similar extension schools are held in Michigan, New York, Wisconsin, Ohio, North Carolina, Pennsylvania, Missouri, and other States.

OTHER INFORMATION SOURCES

Highbush Blueberry Production Guide (200 pp, color), Northeast Regional Agricultural Engineering Service, 152 Riley-Robb Hall, Cooperative Extension, Cornell University, Ithaca, NY 14853.

Small Fruit Crop Management (608 pp), Prentice Hall. Mail Order Billing Dept.,200 Old Tappan Road, Old Tappan, NJ 07657.

Growing Blueberries in Missouri (26 pp), State Fruit Experiment Station of SMSU, Mountain Grove, MO 65711.

Hints on Growing Blueberries (8 pp), Bulletin Office, 10B Agriculture Hall, Michigan State University, East Lansing, Ml 42824.

Fruit and Vegetable Clip Art for Direct Marketers University of Illinois, Department of Horticulture, Dixon Springs Agricultural Center, Simpson, IL 62985.

Small Fruit Production and Pest Management Guide (111 pp), Publications Distribution Center, 112 Agricultural Administration Building, The Pennsylvania State University, University Park, PA 16802.

The Highbush Blueberry and Its Management(270 pp), The Haworth Press Inc., 10 Alice Street,, Binghamton, NY 13904.

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CHAPTER 11

BLUEBERRIES

All uses of fungicides, pesticides, and herbicides must be registered by appropriate State and/ or Federal agencies before they can be recommended.

CAUTION: Fungicides, pesticides, and herbicides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all products selectively and carefully. Follow recommended practices for the disposal of surplus products and their containers.

By J.D. Kindhart, University of Illinois, and George B. Holcomb, Office of Communication, U.S, Department of Agriculture (USDA), for USDA's Office for Small-Scale Agriculture (OSSA); Howard W. "Bud" Kerr Jr., Program Director, Ag Box 2244, Washington, DC 20250-2244. Telephone: 202-401-1805; Fax: 202-401-1804.

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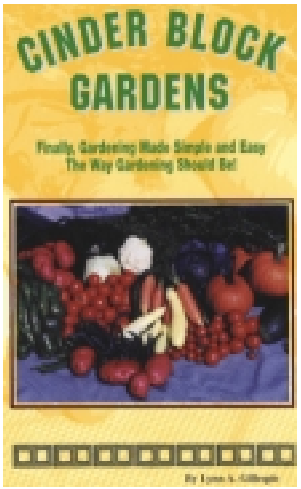

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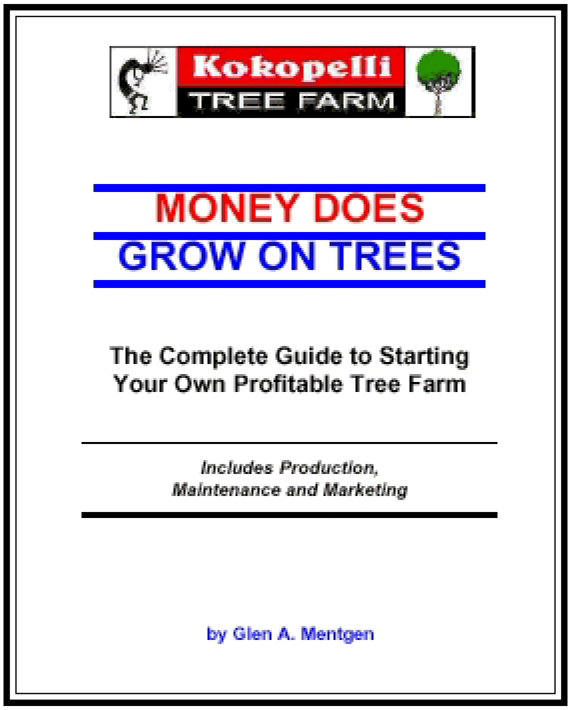

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